AN EXAMINATION OF INTERCONTINENTAL BALLISTIC MISSILE DEVELOPMENT WITHIN THE UNITED STATES FROM 1952 TO 1965

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ABSTRACT

AN EXAMINATION OF INTERCONTINENTAL BALLISTIC MISSILE DEVELOPMENT WITHIN THE UNITED STATES FROM 1952 TO 1965, by Major Jeffrey A. Bair, USAF, 96 pages.

Intercontinental ballistic missiles (ICBM) development by the United States from 1952 through 1965 is marked by extreme urgency. The initial impetus for the development did not proceed within military channels; this paper explores possible reasons why the military channels were not the originator of the program. These reasons include the competition for mission and resources an ICBM capability represented to manned strategic bombers. Significant technological breakthroughs and strong leadership from key individuals highlight the development process. The development of thermonuclear weapons helped make ICBMs possible, but no single technological breakthrough made the development of ICBMs possible. In the same way, the leadership was not generated by a single source. The leadership of General Bernard Schriever and Mr. Trevor Gardner represent a significant contribution to the journey. The management concept known as concurrency helped shorten the timelines and was teamed with a full employment of the weapon system concept and unprecedented authority within the organization responsible for the development were significant to the successful deployment. The last area examined is the revolution in military affairs produced by the mating of thermonuclear weapons and ballistic missiles as well as the deterrent policies of the administrations that provided the doctrine for this revolution.

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ACRONYMS

AFB	Air Force Base
ARDC	Air Research and Development Command
BSD	Ballistic Systems Division
CEBMCO	Corps of Engineers Ballistic Missile Construction Office
CINCSAC	Commander in Chief, Strategic Air Command
DCS/D	Deputy Chief of Staff, Development
DoD	Department of Defense
ICBM	Intercontinental Ballistic Missiles
IRBM	Intermediate Range Ballistic Missile
NSC	National Security Council
OSD	Office of the Secretary of Defense
RAND	Research and National Defense
RMA	Revolution in Military Affairs
SAC	Strategic Air Command
STL	Space Technologies Laboratories
TRW	Thompson-Ramo-Wooldridge
WDD	Western Development Division
WMD	Weapons of Mass Destruction

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CHAPTER 1

INTRODUCTION

Thesis

This study examines efforts of the United States to develop and deploy intercontinental ballistic missiles (ICBM) in the years from 1952 through 1965. The specific areas addressed include background information setting the stage for the extreme urgency under which these weapon systems developed including the major committees that moved the process forward. This paper examines how this initial impetus for the development did not proceed within military channels and explores possible reasons why the military channels were not the originator of the program. In addition, this study examines the technological problems that required solutions to deploy an operational weapon system. This paper also addresses the leadership of General Bernard Schriever and Trevor Gardner as well as defining the management concept known as concurrency used to shorten the required deployment timelines. Finally, this study examines the revolution in military affairs produced by the mating of thermonuclear weapons and ballistic missiles as well as the deterrent policies of the administrations that provided the doctrine for this revolution.

Setting the Stage

With the clear vision provided by hindsight, it is difficult to imagine a time when the technology of the Soviet Union led the United States. The collapse of the Soviet Union has clouded any vision of former power. The Soviet Union demonstrated its power and technological advantage on 4 October 1957 with the launch of Sputinik1 and, again, on 3 November 1957 with the launch of the much larger Sputnik 2. In the summer

of 1957, prior to the Sputnik launches, United States radar in Turkey plotted the first successful launch of a Soviet ICBM.[1] The United States had not ignored the development of ICBM but these launches were clear indications of the substantial lead enjoyed by the Soviets. The Sputnik launches greatly increased the attention of Congress and the general public on the issues of technology and space capabilities to include the ICBM programs. Since late 1953, the ICBM research and development program within the United States received strong support in funding (although the funding was not unlimited and was cut by twenty percent just prior to the launches in the Soviet Union) and became a focused enterprise. While the launching of the Sputniks impacted the public's perception, the ICBM program could not be accelerated any faster because it was already working at maximum effort.[2] The demonstration of Soviet capabilities had its greatest impact upon the number of ICBMs deployed. The original United States ballistic missile program intended a force of twenty to thirty missiles.[3] At the peak, the final number was closer to 1,000 missiles than the 30 originally envisioned. Atlas was the first ICBM deployed by the United States and it reached initial operations alert in September of 1959 at Cooke Air Force Base (AFB), California only five years after ICBM research and development reached its highest priority ranking. From 1954 until 1962, the United States deployed three distinct ICBM weapons systems, including the Minuteman weapon system, the direct descendant of which, the Minuteman III, remains on alert today. During the same era, the F-102 fighter required ten years to develop from concept to completion.[4] Considering there were already operational jet fighters in the inventory during the development of the F-102 and no ICBM existed prior to start of the program help place the accomplishment in the appropriate perspective. The development of the

ICBM was a truly national project focused by the height of the Cold War and even debated in the 1960 Presidential campaign.

Significant problems required resolution before deployment of an operational weapon system. The requirements of the weapon system define these problems--deliver a bomb 5,000 plus miles to a target. Within this simple statement huge technical challenges had to be overcome, like the shape and material of the reentry vehicle to preclude its burning up during reentry through the atmosphere, the amount of energy required to propel an object that distance, and a guidance system to make it arrive at the designated target. In addition to the technical problems, the more mundane support buildings, equipment, and training for personnel to operate and maintain the weapon system needed to be developed. The solutions may appear deceivingly simple, but even in 2003 many countries with significant resources at their disposal, and the knowledge of the solutions to these problems, are unable to deploy an ICBM.

Initial Research

The United States Air Force's research into ballistic missiles was not created in response to the sensation of the Sputnik launches. The leadership of the Air Force had been pursuing missile technology even before the Air Force became a separate service. This pursuit is best described in fits and spurts as the Air Force attempted to fit a new technology into well understood operations. As early as World War I, the United States military was exploring the possibilities of missile technology. "Tests of preset flying bombs (which could not be guided after launch) were conducted by the Air Service in 1918 and 1919. C. F. Kettering, E. A. Sperry of Sperry Gyroscope Co., and Orville Wright assisted in the development and test of these missiles. One Air Service Officer

closely involved in this project was Colonel Henry H. Arnold. . . ."[5] No Air Service guided missile entered combat during World War I, but testing did continue throughout the war and after its conclusion. Plans and budgets throughout the 1920s and 1930s repeatedly projected more research on the "torpedo airplane," but budget cuts eliminated all efforts until 1938. In 1938, the Army Air Corps Engineering Division designated military characteristics for the program and instituted a design competition, but an adequate design was never submitted.[6]

Following World War II, Commanding General of the Army Air Forces, Henry H. "Hap" Arnold, attempted to point the Army Air Forces to the future. Part of this effort was the commissioning of Dr. Theodore von Kármán's seminal study, *Toward New Horizons,* presented in December 1945. The task given to Dr. von Kármán's group was to survey the technological and scientific advances of World War II and provide recommendations on what advances should be pursued. Among the recommendations was one for missile development, which was to emulate the German efforts within rocket development with a single manager program and adequate funding for research and development. The group concluded missiles would not be effective until the technology had improved considerably. The group recommended to emphasize jet aircraft and concomitantly to pursue an orderly sequential guided missile development program based on air-breathing jet propulsion.[7] The technology for air-breathing jet propulsion and jet-assisted take-off blended with the previous missions of manned aircraft as opposed to the development of a ballistic missile capability that would not be a direct descendant of World War II era strategic bombing.

The Air Force and the Department of Defense (DoD) attempted to follow the recommendations provided in Dr. von Kármán's report. The transition to the development of ballistic missiles was slowed by the constant fight for funding between competing programs and limited budgets. The overall funding reductions following World War II led to significant cuts in research and development and the unproven technology of an ICBM was an easy target. The cost cutting measures led to the cancellation of the MX-774, the original designation for the Atlas program in July 1948. The Air Force instead choose to focus its limited research and develop funding on air breathing rocket systems that used aerodynamic lift instead of a ballistic trajectory to travel to the target.[8] The development of these systems appeared simpler and more readily achievable than ICBMs. The two programs the Air Force focused on were the Snark and the Navaho, and both of these programs continued to receive funding even after the funding for Atlas was eliminated. The Air Force believed the Snark and Navaho could aid in the development of ICBM technology, but only the initial booster engines of the Navaho proved adaptable to other pursuits. The Navaho never reached an operational capability, and the Snark was briefly deployed before being dismantled. The level of funding differences for these programs between 1951 and 1954 is significant. The Atlas program received $26.2 million, of which $18.8 million was fiscal year 1954 funds. In contrast, the Snarl program received $226 million, and the Navaho program received $248 million.

The potential represented by an ICBM was not completely forgotten, and the Air Force tasked the Research and National Defense (RAND) Corporation to monitor the technology and recommend when the utility of ICBMs seemed feasible.[9] In December

1950, RAND reported that the utility was achievable. In the interim years, Convair, the original contractor for MX-774, had continued limited research without support from the Air Force. The Korean War prompted an increase in defense spending and renewed intensity of the Cold War. The Atlas program was injected with some limited funding as project MX-1593 from supplemental fiscal year 1951 funds.[10]

In addition to the funding limitations, another problem area in developing the new missile technology was the continuing fight over roles and missions. This confrontation included the usual arena between the services and a unique battle internal to the Air Force. The services attempted to ensure a fair share of the defense budget in an era when the focus for all force structures was increasingly nuclear. The Navy created the submarine launched ballistic missile, Polaris, and pursued the "super carrier" as another nuclear delivery platform. The Army focused on shorter-range ballistic missiles, but initially tried to compete with the Air Force for development and control of the ICBM program. The conflict over which service would control ICBMs was not resolved until 1956. The battles internal to the Air Force involved the conflict between the proven capabilities and known technology of manned bombers and the unknowns of the ICBM. Creating the ICBM weapon system would limit funds for the workhorse of the Air Force, the manned bomber, and perhaps even produce a threatening discussion for the elimination of the young service as a separate entity. The growth of the Army Air Force and the separation of the Air Force as an independent service rested upon the doctrine of strategic bombardment. The following excerpt summarizes this conflict between the known capability and the unknown potential:

> The doctrine of strategic bombardment advanced quickly in the 1930s in part because the Air Corps was not expected to carry, certainly not by itself, the awesome responsibility for national defense. Air planners and thinkers, unburdened by any capital or conceptual investment in the existing order, and not in a position where the immediate survival of the nation rode on their work, were free to move outside the "conventional wisdom" and dream new dreams. . . . In sum air leaders tried to balance the conflicting requirements of upholding the lessons of the past while planning for the future, represented in part by the missile, that seemed increasingly discontinuous. In this they faced one of the central dilemmas of military doctrine. A natural tendency, when faced with such a dilemma, was to hold to what had worked in the past. An indicator of this tendency is that the drive for rapid missile development in the early and mid 1950s came not from the uniformed Air Force, but from civilian advisors and scientists--Trevor Gardner and the Teapot Committee, and the Gillette and Technological Capability Committees.[11]

Teapot, Gillette, and Gaither Committee: Breaking the Thermonuclear and Bureaucratic Barriers

A significant amount of effort was required to overcome the inertia that had stopped the development of the ICBM. The DoD initiated a study to examine ballistic missiles in order to eliminate unnecessary programs and focus limited resources. Mr. Trevor Gardner was a recent hire in the office of the Secretary of the Air Force, and he took this opportunity to change history. Trevor Gardner, the Special Assistant for Research and Development, was the force behind the committee formed to study the ballistic missile problem, and he stacked the committee with respected scholars and businessmen who were favorably predisposed towards the development of ballistic missiles.[12] The official name was the Strategic Missile Evaluation Committee, but it became known as the Teapot Committee. Professor John von Neumann chaired the Teapot Committee. Several people associated with the Teapot Committee became important contributors throughout the development of United States ICBMs. For example, Colonel Bernard A. Schriever ran the Air Force office within the Pentagon that

provided support to the Committee and two scientists who became de facto members of the Committee were Drs. Simon Ramo and Dean Wooldridge. The report from the Teapot Committee was submitted in February 1954 and recommended the Atlas development be accelerated and that the weapon system could be deployed by 1960.[13]

This was the first time a blue ribbon panel clearly stated the technology was readily achievable. One of the Committee's recommendations was the creation of a single controlling authority to oversee the development of the ICBM program. Trevor Gardner also worked the problem to solve this issue. "In September 1955 he established a special committee, chaired by Hyde Gillette, to review the management system. The Gillette Committee recommendations approved by OSD [Office of the Secretary of Defense] in November, bypassed much of the intermediate management reviews in the Air Force that were delaying rapid missile development."[14]

The Teapot Committee knew more than just streamlined management techniques were required to develop and deploy ICBMs. For instance, as previously mentioned, problems of weight, energy, accuracy, and reentry must be resolved. One of the critical technologies was the weapon the ICBM is designed to deliver and was described, in part, by the weight category. The weight required for an effective atomic bomb when the accuracy is measured by miles from the target, began to exceed known or projected lift capabilities. The development of thermonuclear technology greatly reduced the weight required to achieve a yield large enough to compensate for the accuracies planned for in the first generation of ICBMs.

The Teapot Committee was aware of the advances in thermonuclear technology. The first man-made thermonuclear explosion was a "wet" Shot Mike in November 1952.

This explosion was more a proof on concept than a legitimate weapon since it weighed over sixty-five tons and was the size of a building.[15] The Soviets followed the Mike Shot with their own thermonuclear explosion less than one year later, but they had surpassed the United States, since they developed a dry thermonuclear explosion readily adaptable to a weapon.

While the Teapot Committee focused on the technical requirements and problem solution before an ICBM could be deployed and the Gillette Committee solved the bureaucracy entanglements, the Gaither Committee examined the international security requirements to determine a need for the weapon system. In April 1957, President Eisenhower chartered an ad hoc committee to examine a proposal to spend $40 billion on the construction of blast shelters. H. Rowan Gaither chaired this group, which became known as the Gaither Committee. Mr. Gaither was also the chairman of the board of trustees at the RAND Corporation, and he expanded the study to include all aspects of the strategic environment with the Soviet Union. The Gaither Committee's report was published on 7 November 1957, a week after the launching of Sputnik I and presented to President Eisenhower and the National Security Council (NSC).[16]

The Gaither Committee agreed with a groundbreaking study from Albert Wohlstetter and concluded the vulnerability of American strategic forces to surprise attack made the United States a first strike power. Dr. Wohlstetter, a RAND employee, was briefing the defense community that as many as eighty-five percent of the Strategic Air Command's (SAC) bombers would be destroyed on the ground by a Soviet surprise attack.[17] With the example of Pearl Harbor in the recent past, the surprise attack carried significant resonance. These studies brought to light the vulnerability of strategic

bombers and their heavy reliance upon foreign bases. The use of these bases made the force susceptible to a first strike that would either destroy the bombers at these bases or destroy their refueling locations.[18] The Committee recognized deterrence must be based upon the ability to produce unacceptable losses to an adversary after surviving a first strike.[19] With the loss of so much of the force to a surprise first strike, the United States would be left open to nuclear extortion.

The Gaither Committee believed the top echelons of the government did not fully appreciate the threat from the Soviet Union. To avoid the threat of an overwhelming Soviet surprise attack, the Committee recommended the dispersal of SAC bombers, airborne alert for a percentage of SAC bombers, shelters capable of withstanding an overpressure of 100-200 pounds per square inch, and the acceleration of initial operational capability for ICBMs and development of intermediate range ballistic missile (IRBM), which became Thor and Jupiter.[20] The committee believed IRBM development could be added to the operational inventory quicker than the longer-range ICBM. While President Eisenhower accepted the recommendations on development and deployment of IRBMs, many of the Committee's recommendations were not implemented. "He believed that American strategic forces were stronger than the committee indicated, and he objected to the fact that they had not indicated any priorities for spending."[21] The combination of the Gaither report and the Sputnik launches created significant pressure upon the Eisenhower administration.

The pressure upon the Eisenhower administration was increased by a report from the Rockefeller Brothers' Foundation. The Rockefeller Report has been related as an unclassified version of the highly sensitive Gaither report.[22] The Report was prepared

under the direction of Harvard History Professor, Henry Kissinger, and covered a larger field than the Gaither report. The Gaither and Rockefeller studies shared about a dozen key contributors. During the Presidential campaign in 1960, John Kennedy referenced the Rockefeller Report in a speech on national defense to an American Legion convention in Miami Beach.

Missile Gap

In the late 1950s and into the presidential campaigns of 1960, the "missile gap" entered the lexicon of America. The missile gap described a time in the early to mid-1960s when the number of deployed Soviet Union ICBMs would surpass the number of deployed United States ICBMs. The original source of the missile gap numbers is not clear. During the timeframe in question, Joseph Alsop, a syndicated columnist, provided the following future United States and Soviet Union ICBM numbers:

Table 1. Joseph Alsop's Estimation of the Missile Gap

	1959	1960	1961	1962	1963
United States	0	30	70	130	130
USSR	100	500	1,000	1,500	2,000

Desmond Ball believed these figures closely approximated the National Intelligence Estimates at the time.[23] The platform for the Democrats in 1960 (endorsed by Kennedy during his acceptance speech) included the following position on United States' defense "the Communists will have a dangerous lead in intercontinental missiles

through 1963--and that the Republican administration has no plans to catch up . . . our military position is measured in terms of gaps--missile gap, space gap, and limited war gap."[24] The 1960 presidential election between Kennedy and Nixon was one of the closest in history, and the existence of a missile gap was an important part of the differences between the two candidates. Richard Nixon, President Eisenhower's Vice-President, could be held politically culpable for the existence of a missile gap.

The Eisenhower Administration actively attacked the missile gap accusation. During his State of the Union in January 1960, President Eisenhower highlighted the fourteen consecutive successful Atlas test launches and the fact that the first complex of Atlas missiles was operational. In March 1960, President Eisenhower attempted to address the missile gap in a seventeen-page letter to some 600 business leaders.[25] The letter addressed the issue that national security and deterrence of the Soviet Union did not rest upon solely matching the Soviets in missiles. The letter stressed that the overall military strength was the important measure. The Secretary and the Chief of Staff of the Air Force both supported this position in their testimony to Congress during the final year of the Eisenhower Administration. In addition General Power, Commander in Chief SAC, agreed with the overall position and stated "Deterrence is composed of a great many things."[26]

With the corrected vision brought on by examining the events after they occur, it is now widely accepted that a missile gap never existed. A common viewpoint is President Eisenhower knew from the U-2 flights that the Soviet Union could not create a numerical superiority in ICBMs. It is unclear what information from the U-2 over flights was made available to Senator Kennedy prior to him being elected President.[27]

Conclusion

The launching of the Sputniks and the test firing of the ICBM by the Soviet Union demonstrated their clear advantage. These actions impacted the ICBM force structure deployed by the United States Air Force, but the major studies that helped initiate the process started on the civilian side of the chain of command and occurred before the Sputnik launches. While the United States military conducted some research into "preset flying bombs" in 1918 and 1919, these efforts failed to produce a weapon system and demonstrated only a slight interest. Following World War II, research and development budget reductions stopped progress long before an operational weapon system was developed. In the early 1950s, much of the leadership within the military side of the Air Force was wedded to the manned bomber. The ICBM competed with the manned bomber for limited resources and mission. The major muscle movements that started the development of the ICBM came from civilians within the military establishment who possessed fewer ties to existing capabilities or methods. Thus, the ICBM belonged to an organization that did not initially push for its existence.

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[1]Harry E. Goldsworthy, "ICBM Site Activation," *Aerospace Historian* 29, no. 3 (fall/September 1962): 154.

[2]John Clayton Lonnquest, "The Face of Atlas Intercontinental Ballistic Missile 1953-1960" (Ph.D. diss., Duke University, 1996), 251-252.

[3]Desmond Ball, *Politics and Force Levels* (Berkeley: University of California Press, 1980), 43.

[4]Walter J. Boyne, "The Man Who Built the Missiles," *Air Force Magazine* (October 2000): 86.

[5]Edmund Beard, *Developing the ICBM* (New York: Columbia University Press, 1976), 15-16.

[6]Ibid., 16.

[7]Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945-1960*, (Washington DC: Office of Air Force History United States Air Force, 1990), 24.

[8]Ibid., 37.

[9]Ibid., 68.

[10]Ibid.

[11]George A. Reed, "U.S. Defense Policy. U.S. Air Force Doctrine and Strategic Weapons Systems, 1958-1964: The Case of the Minuteman ICBM" (Ph.D. diss., Duke University, 1986),40. (UMI Dissertation Services, Ann Arbor, Michigan: UMI Dissertation Services, 1999).

[12]Ibid., 34.

[13]Neufeld, *Development of Ballistic Missiles*, 261.

[14]Reed, 36.

[15]G. Harry Stine, *ICBM: The Making of the Weapon that changed the World* (New York: Orion Books, 1991), 162. A thermonuclear device is created from the compression of the heavy isotopes of hydrogen, deuterium and tritium, by the energy released from fission device, which release . The "wet" shot refers to the use of liquid hydrogen as the source for deuterium and tritium. The "dry" shot uses the compound lithium-6 deutride to provide the provide the tritium, which is liberated by neutrons from explosion of the fission device. The source for this information is available from http://www.fas.org/nuke/intro/nuke/design.htm http://nuketesting.enviroweb.org/hew/Nwfaq/Nfaq2.html; Internet; accessed on 16 May 2003

[16]Ball, *Politics*, 27.

[17]Albert J. Wohlstetter, "The Delicate Balance of Terror," (RAND P-1472) 14, Available on line at www.rand.org/publications/classics/wohlstetter/P1472/P1742.html; Internet; accessed on 25 February 2003.

[18]Wohlstetter, 14; Reed, 44-45.

[19]Ball, *Politics*, 28.

[20]Ibid., 28-29.

[21]Reed, 45.

[22]Ibid., 46.

[23]Ball, *Politics*, 7.

[24]Ibid., 18.

[25]Neufeld, *Development of Ballistic Missiles*, 200.

[26]Ibid., 201.

[27]Ball, *Politics*, 54.

CHAPTER 2

SCHRIEVER'S IMPACT

> World War I was won by brawn, and World War II by logistics. World War III will be won by brains.[1]
>
> General of the Armies "Hap" Arnold, circa 1945

Background and Program Development

While the world can celebrate that World War III has not occurred, the nuclear deterrent forces of the United States validated General Arnold's statement by helping preclude World War III. A key contributor to this deterrent force has been the ICBM and a key contributor to the development of that ICBM force was General Bernard Schriever. General Arnold placed Schriever in the position of Air Staff scientific liaison. From this position, "Schriever would meet some of the nation's most brilliant scientists, who after World War II would move into prominent positions of power."[2] Schriever later stated that:

> I became really a disciple of the scientists who were working with us in the Pentagon, the RAND Corporation also, so that I felt very strongly that the scientists had a broader view and more capabilities. We needed engineers, that's for sure, but engineers were trained more in a . . . narrow track to do with materials than with vision.[3]

While Schriever recognized the importance of science and technology, he wrote, "In the task of acquiring modern aerospace systems today, the pacing factor is management--not science and technology."[4] The efficient use of research and development funding and the timely translation of new technologies into operational weapon systems was a critical form of leadership.

Schriever's work as the scientific liaison at the Air Staff laid an important foundation; one he would later exploit when he commanded the Western Development Division (WDD). As the scientific liaison, Schriever participated in the creation of the Air Force research and development infrastructure, which included test facilities at Cape Canaveral, in the Mojave Desert, and at Hanscom Field. (All of these facilities would play crucial roles in the development of an ICBM.) After attending the National War College, Schriever returned to the research and development arena in the newly formed office Deputy Chief of Staff, Development (DCS/D) as the Deputy to the Chief of the Assistant for Evaluation Office. He became the chief when his boss departed for the private sector. This office within the DCS/D was responsible for plans for the development of future Air Force systems and technologies. In order to develop the assets the Air Force needed to operate in the next war, inputs and ideas came from two sources. These sources were either, an "operations pull" from the needs of current operations, or a "technology push" from the expertise of scientists. During his time in this office, Schriever became the point man for a critical change in how and which technologies would be explored for operational development. Instead of focusing on the operational command and its perceived needs, he developed new procedures that used systems analysis of future technologies, strategies, and objectives along with requirements from current operations to establish developmental planning for future systems.[5] This was a significant departure from previous procedures and opened the doors for new technologies that did not have an existing advocate within the operational commands.

These new procedures led to differences with entrenched powers in the Air Force. On one occasion, Schriever battled General Curtis E. LeMay over the procurement of the

B-52 bomber. Schriever recommended the Air Force re-engine the B-47 bomber instead purchasing the B-52. General LeMay vehemently opposed this idea and eventually won, but Schriever held his ground and earned the respect of LeMay, General Nathan F. Twining, and General Thomas D. White in the process.[6] Schriever has stated he did not win too many battles, except on missiles, where there were fewer entrenched interests.[7] His battles and work were not in vain and led to the now familiar "weapon system" concept with the Air Force. This concept looks at the complete life cycle and all the requirements to deploy a new capability beyond the actual machine to include the various aspects associated with the machine. These aspects include the operators, maintainers, depot-level maintenance, upgrade capabilities, and others. This overarching philosophy of a weapon system being a true system would see its full implementation in the development of the ICBM.

His work in the future capabilities and concepts had exposed Schriever to the theories and ideas behind ICBMs. Schriever learned of the successful American thermonuclear test and the potential for a much lighter and more powerful thermonuclear weapons at a meeting of the Scientific Advisory Board in 1953. He understood the implication for an ICBM capability immediately. Schriever later recalled, "I almost came out of my seat, realizing what this meant for the ICBM."[8] After consultations with Dr. von Neumann, who was a consultant to both the Atomic Energy Commission and to Convair for the Atlas ICBM program, Schriever confirmed his opinion and started work to have the findings on thermonuclear weapons recognized within the formal chain of command and to explore their impact on ICBM development. Schriever understood he needed a formal finding to re-energize the ICBM program, and he approached Lieutenant

General (Retired) Jimmy Doolittle to help get his message to the Chief of Staff of the Air Force. Doolittle was serving a scientific advisor to the Chief, and his experience as a pioneer in aircraft development and as a combat leader provided instant credibility. Doolittle spoke with Air Force Chief of Staff, General Vandenberg, to have the Scientific Advisory Board investigate the question.[9] Schriever's efforts coincided with the work of Trevor Gardner, Special Assistant to the Secretary of the Air Force for Research and Development, who headed a DoD study on guided missiles and was the driving force behind the forming of the Teapot Committee.

As a result of the studies, the Air Force made Atlas its highest research and development priority on 14 May 1954. Since much of the aircraft industry and especially Convair were located in southern California, the Air Force established its ICBM development organization in Inglewood, California. The Air Force chose newly promoted Brigadier General Schriever to command the WDD of the Air Research and Development Command (ARDC) taking command on 2 August 1954. At the WDD, Schriever faced the basic question of how to manage the complex task of developing an ICBM. The problem was not just managing all the separate activities required, but the daunting task of creating an entirely new capability. No organization had experience and the Air Force lacked the technical expertise required to supervise the development of the technology.

Two methods of contracting were available to Schriever. One was the prime contractor method, where the government gave funding to one company to manage and integrate the entire system. A second way was the associate contractor method, where the government hired one company to create specifications and oversee the system, and

hired other companies to develop components.[10] The choice came down to either Convair as the prime contractor or finding a firm to be the systems integrator. Hiring Convair assumed they had the wherewithal to design and build the product, a conclusion the Teapot Committee did not support. Specifically, the report recommended, "All production engineering effort by Convair should be halted" and that "The most urgent need in the IBMS [the acronym had not been changed to ICBM, which avoids confusion with IBM--International Business Machines] program is setting up of the above-mentioned new IBMS development-management agency for the entire program, including the Convair effort."[11] Eliminating Convair did not provide an answer, but that answer was provided through the Teapot Committee in the form of Drs. Simon Ramo and Dean Wooldridge. These gentlemen actively participated on the Teapot Committee and would form the Ramo-Wooldridge Company (they removed themselves from further Dr. von Neumann committees on ICBMs to avoid a conflict of interest).

One of the Schriever's first actions as head of the WDD was hiring Ramo-Wooldridge for systems engineering and integration. Without the requirements to follow civil service regulations and without significant contractual and conflicts of interest, Ramo-Wooldridge hired the requisite scientific and technical expertise. As Schriever later explained:

> Complex requirements of the ICBM and the predominant role of systems engineering in insuring that the requirements were met, demanded an across-the-board competence in the physical sciences not to be found in existing organizations. Scientists rated the aircraft industry relatively weak in this phase of engineering, which was closely tied to recent advances in physics. The aircraft industry, moreover, was heavily committed on major projects, as shown by existing backlogs. Its ability to hire the necessary scientific and engineering talent at existing pay-scales was doubted and with the profit motive dominant,

> scientists would not be particularly attracted to the low-level positions accorded to such personnel in industry.[12]

The WDD could more easily direct Ramo-Wooldridge, as opposed to Convair, because Ramo-Wooldridge did not have many other contacts and was not part of the production side of the ICBM program since at that time the company had no production capabilities.[13]

Although the method is now familiar in DoD contracting, the ICBM program pioneered the way from the prime to the associate contracting method. An example within the development of the B-58 bomber will help illuminate the difference between the two systems. The prime contractor for the B-58 was Convair who subcontracted with Sperry for the Bomb and Navigation subsystem. Sperry subcontracted with Raytheon for the Bombing radar and the Navigation radar. Under the prime contracting method, the Air Force did not have insight into the subcontractors and dealt directly with Convair. Teams at Raytheon could only talk to Sperry and Sperry could only talk to Convair and not directly to the Air Force. Convair would make the tradeoffs in problem areas and pushed the problems down to the subcontractors. This left the Air Force with limited visibility into the complete project.[14]

Schriever insisted on visibility into all aspects of the ICBM program. With the construction of operational facilities proceeding at the same time as the development and testing of the missile systems, a problem in one area might have significant impacts on many others. These problems could not be addressed as the development entered another phase because that phase was already under way. Schriever addressed the need for detailed tracking of all aspects by implementing “Black Saturdays.” On one Saturday

every month, the entire program was briefed in detail to the leadership at WDD. These briefings ensured everyone knew the successes and failures within the entire program and whether or not adjustments were needed elsewhere in the program.

The aircraft industry in general and Convair in particular did not want their authority usurped by the new competitor--Ramo-Wooldridge. The perception that Ramo-Wooldridge had an unfair relationship with the Air Force warranted action by Schriever. On 25 February 1955, the Air Force, acting on the recommendation of Schriever, prohibited Ramo-Wooldridge from engaging in ICBM hardware production.[15] This action helped placate the concerns of Convair and others, but the conflict of interest issue would return. Ramo-Wooldridge had a minority investor relationship with Thompson Products. Competitors in the ICBM business feared Thompson Products would monopolize the supply of structural parts for missiles and Ramo-Wooldridge would capture the electronics market for the ICBMs as well.[16] Thompson Products and Ramo-Wooldridge merged in 1958 to form Thompson-Ramo-Wooldridge (TRW). Prior to the merger, Ramo-Wooldridge established Space Technologies Laboratories (STL) as a separate entity within Ramo-Wooldridge. Under TRW, STL became an independent but wholly owned subsidiary of TRW with Jimmy Doolittle as its Chairman of the Board.

Following these developments, Brigadier General Schriever concluded the only way to maintain STL's critical participation and avoid suspicion was to complete a separation from TRW.[17] Schriever testified to Congressional committee about this separation, and in September 1959 a Congressional report recommended converting STL to a nonprofit institution similar to RAND. The creation of the Aerospace Corporation in 1960 from STL resolved the issue. The Aerospace Corporation exists today with a

similar mission of providing technical advice to the Air Force: "The Aerospace Corporation is a private, nonprofit corporation created in 1960 under the laws of the state of California. The purposes of the corporation are exclusively scientific: to provide research, development, and advisory services. . . . The corporation's primary customer is the Space and Missile Systems Center of Air Force Space Command, [Space and Missile Systems Center is the follow-on organization to WDD after several name changes] although work is performed for other agencies, international organizations, and governments in the national interest."[18] Schriever directly involved himself in this resolution of the conflict of interest while maintaining the expertise that would otherwise been unavailable to the government or the Air Force.

The beneficial operational results of the partnership of WDD and Ramo-Wooldridge were almost immediate. One of the first areas Ramo-Wooldridge investigated was the nose-cone design of the reentry vehicle for the Atlas. In conjunction with the Atomic Energy Commission, Ramo-Wooldridge found that Convair's design suffered from excessive reentry heating. Ramo-Wooldridge developed an alternative blunt nose cone design that reduced the temperatures and reduced the weight by half.[19] The original idea and design of the blunt type nose cone was largely the brainchild of H. Julian Allen of the Ames Laboratory of the National Advisory Committee for Aeronautics.[20] The contribution from Ramo-Wooldridge should not be discounted without their expertise and pursuit of alternative solution the program would have suffered delays.

In order to accomplish its mission, WDD needed to work with three key organizations within the Air Force. The first was ARDC. One of the factors Brigadier

General Schriever cited for the successful development of the ICBM was that General Thomas S. Power as the Commander, ARDC, made Brigadier General Schriever "assistant to the commander for ballistic missiles."[21] This provided Brigadier General Schriever with the authority required to work with that command. The procedures for the interface between WDD and ARDC were not formalized for another six months. The strong bond of trust between the General Power and Brigadier General Schriever was critical in this direct working relationship and would continue to be important when General Power became the Commander in Chief, Strategic Air Command (CINCSAC), which was the operational command for the ICBM forces. The relationship with Air Materiel Command was not as straightforward. With WDD under a different major command than the personnel from Air Materiel Command, coordination problems were almost guaranteed. The Air Materiel Command personnel assigned to WDD were placed under Brigadier General Schriever's control ". . . they (the Air Materiel Command personnel) would be directly under my control, and I would write their efficiency reports."[22] This unique situation worked well, but there were still problems. Brigadier General Schriever typically solved these problems with his strong interpersonal skills. As Schriever later recalled his working relationship with General Rawlings and General McKee was so strong he could call on the phone to fix personnel problems without writing a letter.[23] The final critical relationship for WDD was its dealings with the von Neumann Committee, which was continued to as an advisory committee to ICBM program. Schriever's strong working relationship with the committee continued and the committee provided important credibility to leadership in the Pentagon and the Office of the Secretary of Defense.[24]

Gillette Procedures

Schriever and Gardner used another agency outside of the military to increase support for the ICBM program. This time Gardner approached the Office of Defense Mobilization Scientific Advisory Committee with the message about the need to redirect the Air Force's research and development program "to make better use of new and emerging technologies, and he argued that the ICBM program should be the centerpiece of the effort."[25] Before they had an opportunity to carry Gardner's message forward, President Eisenhower tasked the committee to study how science and technology could be used to protect the United States from surprise attack. The Office of Defense Mobilization Science Advisory Committee formed the Technologies Capabilities Panel under the chairmanship of James Killian, the president of the Massachusetts Institute of Technology, to address the President's tasking. This panel became known as the Killian Committee and received several briefings from Gardner and Schriever on the status of the ICBM program.[26] In February 1955, the Killian Committee briefed President Eisenhower and the NSC on its findings. The committee believed the ICBM program was progressing and was managed, but warned of potential problems within restrictive development procedures. To alleviate the risk of delay, the Killian Committee recommended that the NSC recognize the ICBM program as a "nationally supported program of the highest order."[27]

On 28 July 1955, Schriever, Gardner, and von Neumann briefed President Eisenhower and the NSC on missile program. At the NSC meeting on 4 August 1955, President Eisenhower directed the NSC planning board to prepare a list of proposed changes based on the Killian Committee Report at the 28 July briefing.[28] In September

1955, President Eisenhower approved NSC Action No. 14422, which designated the ICBM program as the nation's highest research and development priority and directed the Secretary of Defense to prosecute it with maximum urgency.[29] The Office of the Secretary of Defense forwarded the decision to the Secretary of the Air Force and directed him to "recommend . . . as soon as possible such additional actions or administrative arrangements as he considers necessary . . . to implement this responsibility."[30]

This tasking led to the creation of a committee led by Hyde Gillette, Deputy for Budget and Program Management in the Office of the Air Force Assistant Secretary for Financial Management, to address the issues. After five weeks of work, the committee released "Air Force Plan (revised) for Simplifying Administrative Procedures for the ICBM and IRBM Programs." The recommendations within this document became know as the Gillette Procedures and were approved in November 1955.[31]

Schriever guided the efforts that created the Gillette Procedures. The Gillette Procedures made WDD solely responsible for planning, programming, and directing ICBM development. The Procedures created a single level of approval within the Air Force, called the Air Force Ballistic Missile Committee, and was chaired by the Secretary of the Air Force. In addition, the coordination required at the Office of Secretary of Defense (OSD) was reduced to one level of approval--the OSD Ballistic Missile Committee. The ICBM Scientific Advisory Council, led by von Neumann, provided technical consultations to both committees. Overall the Gillette Procedures reduced the number of review levels from forty-two to ten.[32] The streamlining of the decision-making process was an important contributor to the successes at WDD.

The development of any new weapon system employing new technology is a daunting task. The deployment of an operational ICBM created difficulties that are easy to overlook on first examination, and involved more than adding a new jet to the inventory and adding a hangar to fit its size. For instance, the ICBM needed basing systems with command and control functions. The requirements for the basing system include where the missile will be launched; how many missiles each launch control center can command; how the systems will be monitored; the power requirements for the support buildings; appropriate personnel manning and training; and a million other details that had not been solved.

Conflicting Programs

While focusing on the actions and programs of Schriever and WDD, it appears the support for ICBMs was universal and involved "blank check" authority. However, all of these activities encountered difficulties. Some in the Air Force saw the ICBM as a direct competitor to the manned bomber. For example, in June 1957, Air Force Chief of Staff, General Thomas D. White, tasked a group of senior officers chaired by Lieutenant General Donald L. Putt, to review the status of missile development. Putt's report concluded the Air Force had clearly not accepted the missile, and the failure to do so was severely hampering the program. Lieutenant General Putt "noted the service's problem was one of emphasis and direction, not organization."[33] General White addressed this lack of support in late September 1957, when he warned a conference of senior air commanders at Patrick AFB, Florida, "that many of them were allowing their dedication to aircraft to turn into a 'battleship attitude' and noted that 'all truths change with time.'"[34] In addition to those who "favored continued reliance on long-range bombers,

and regarded the missile effort as an unnecessary diversion; others, especially in the earlier period, regarded accurate ICBMs as technically unfeasible--for example General LeMay (CINCSAC) stated early in the 1950s, at a meeting of the Von Neumann Committee at Omaha, Nebraska., that 'I can guarantee that 10 years from now there will be no operational long-range ballistic missiles.''"[35] Thus, the early support from SAC was questionable, and is partially documented in that the representative SAC sent to WDD was only a Captain, but SAC came around eventually. SAC focused on operational combat capabilities, and there were many unknowns in the ICBM combat capability. One of the concerns about combat capability was amount of time required to fuel the Atlas in preparation for launch. The requirement developed by SAC was within twelve minutes. Initial deployments of Atlas had difficulty meeting this requirement, but when Atlas was fully fielded the refueling could be accomplished in eight minutes.[36] Another area that helped improve SAC's relationship with WDD was General LeMay's replacement, General Power. General Power was CINCSAC from 1957 to 1964. His understanding and close working relationship with Schriever were critical to the future development and operational deployment of ICBMs.

During the late 1950s, the Eisenhower Administration efforts to balance the budget led to cuts in the ICBM program. For instance, in May 1957, the WDD budget for fiscal year 1958 was reduced by twenty percent.[37] The timeline for deployment was extended and the number of missiles was cut by one-third. These changes were not driven by the progress of the program, but by political and fiscal considerations. In 1957, Trevor Gardner, Assistant Secretary of the Air Force for Research and Development,

resigned in protest.[38] After the Sputnik launches, in the fall of 1957, money was restored, but precious time was lost to the program.

Another example of the difficulties faced by Schriever and his team occurred when Harold Talbott, Secretary of the Air Force when the ICBM program began, tried to reverse a contract decision. According to Dr. Ramo, Secretary Talbott tried to re-open a contract under pressure from a rocket engine manufacturer who had lost out in the competition.[39] Secretary Talbott went to Los Angeles to force WDD to accept a new competition in the rocket engine contract. In attendance were Trevor Gardner, Brigadier General Schriever, Simon Ramo, and Secretary Talbott. After making his case that, the dispersal of contractors required a company away from the west coast should have this contract, Talbott ordered Schriever to re-open the contract and Schriever responded by saying "I can't accept the directive, Mr. Secretary, because I have a prior overriding order. On being handed this assignment, I was directed to run this program so as to attain an operational ICBM capability in the shortest possible time."[40] In the end, Secretary Talbott backed off his demand. As Ramo described it, "Schriever had passed a vital test if he had given in he would have retained his title but lost control of the project. He was now firmly in charge."[41] While the only source for this confrontation is Dr. Ramo's version, the retelling of the incident clearly indicates the level of integrity Dr. Ramo saw in Schriever.

Conclusion

General Schriever led the WDD from June 1954 until 1959. During this period, he led the team that created America's first operational ICBM. He would command the ARDC until its reorganization as Air Force Systems Command, which was the

implementation of his combining research and development with the responsibility to create operational weapon systems. His previous experience as liaison to the scientific community and to what became the Scientific Advisory Board was critical in his success. General Schriever's integrity was demonstrated when he stood up to the wishes of General LeMay (although unsuccessfully) and later when he held his ground against Secretary of the Air Force Harold Talbott. Throughout the ICBM development program, General Schriever demonstrated strong managerial skills in a complex task and requested critical aid when needed. He solved problems by surrounding himself with skilled and knowledgeable employees from Ramo-Wooldridge and with the Air Force officers, he personally selected. With his critical efforts, the program beat the Teapot Committee's estimated operational date by two years.

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[1]Stephen B. Johnson, "Bernard Schriever and the Scientific Vision," *Air Power History* (spring 2002), 32. (Related to Dr. Johnson during an interview with General Schriever 4 March 1999).

[2]Ibid., 32.

[3]Ibid., 32. (Related to Dr. Johnson during an interview with General Schriever 25 March 1999).

[4]Bernard A. Schriever, "The Role of Management in technological Conflict" *Air University Quarterly Review* 14, no. 1-2 (winter spring 1962-1963): 20.

[5]Johnson, 34.

[6]Walter J. Boyne, "The Man Who Built the Missiles," *Air Force Magazine* (October 2000): 83.

[7]Johnson, 34.

[8]Boyne, 84.

[9]John Clayton Lonnquest, “The Face of Atlas Intercontinental Ballistic Missile 1953-1960” (Ph.D. diss., Duke University, 1996), 86.

[10]Robert J. Reed, “New AF Policy Means More Competition--More Selling,” *Aviation Age* 19:8 (August 1953), 22.

[11]Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force*, *1945-1960* (Washington DC: Office of Air Force History United States Air Force, 1990), 260. (Recommendations of the Teapot Committee Appendix 1 of *Development of Ballistic Missiles*).

[12]Johnson, 36.

[13]Ibid.

[14]Neufeld, *Reflections on Research and Development in the United States Air Force*, 63. This passage represents the position of Dr. Getting who is one of the interviewees in this text. Dr. Getting was the vice president at Raytheon at the time of the B-58 development. He later became the first president of the Aerospace Corporation the not-for-profit organization established to eliminate possible conflicts of interest from TRW.

[15]Johnson, 36.

[16]Report by the Committee on Government Operations, House of Representatives, *Organizational and Management of Missile Programs*, 86th Congress, 1st session (Washington DC: 2 September 1959), 81-101.

[17]Ibid.

[18]The Aerospace Corporation, Available from http://www.aero.org/overview/introduction.html; Internet; accessed on 5 January 2003.

[19]Johnson, 36.

[20]Neufeld, *Development of Ballistic Missiles*, 79.

[21]Neufeld, *Reflections on Research and Development in the United States Air Force*, 55.

[22]Ibid.

[23]Ibid.

[24]Ibid.

[25]John C. Lonnquest and David F. Winlker, *To Defend and Deter: The Legacy of the United States Cold War Missile Program* (Rock Island, IL: Defense Publishing Service, 1996), 41.

[26]Ibid.

[27]Footnoted in Lonnquest *To Defend and Deter* back to the original report from the committee to the President. John C. Lonnquest and David F. Winlker, *To Defend and Deter: The Legacy of the United States Cold War Missile Program* (Rock Island, IL: Defense Publishing Service, 1996), 41.

[28]Lonnquest and Winlker, 42.

[29]Ibid., 41.

[30]Ibid., 42.

[31]Ibid.

[32]Neufeld, *Development of Ballistic Missiles*, 120.

[33]Reed, 49.

[34]Ibid., 64.

[35]Ball, *Politics*, 68.

[36]Neufeld, *Reflections on Research and Development in the United States Air Force*, 58.

[37]Neufeld, *The Development of Ballistic Missiles*, 150.

[38]Ibid., 151 133. On 1 March 1955, Gardner nomination as the first Assistant Secretary of the Air Force for Research and Development was confirmed by the Senate Armed Services Committee. Previously, his position had not been a statutory appointment and his duties and authority were not established by law and came from power delegated to him from the Secretary of the Air Force.

[39]Simon Ramo, “Memoirs of an ICBM Pioneer,” *Fortune*, 25 April 1988, 309.

[40]Ibid., 310.

[41]Ibid., 311.

CHAPTER 3

CONCURRENCY, COMPROMISE, AND COMPETITION WITHIN ICBM DEVELOPMENT

> Concurrency was not adopted by the Air Force as the easiest way to produce workable ballistic missiles in an abbreviated time period. It was adopted as the *only* way to reconcile national security requirements with the inexorable hands of the clock.[1]
>
> Major General Osmand J. Ritland, "Concurrency"

Concurrency Defined

To achieve an initial operational capability within the timeframes required, General Schriever and the WDD used a management technique dubbed concurrency. "Concurrency means not only developing a series of subsystems simultaneously but also making decisions well in advance of the receipt of test data that are basic to the decisions themselves."[2] There are generally accepted stages of development: first, an appraisal of the need; second research with diverse investigative activities; third, building a prototype; fourth, flight test; fifth, production; and sixth, deployment with all the construction, building of support equipment, and training of personnel.[3] Concurrency did not eliminate the performance of any of the phases or the myriad activities involved in each phase; concurrency was the simultaneous progress of research and development, production, base construction, training, and support activities. In contrast to the development of a new aircraft, which could use existing runways and repair facilities, the WDD developed completely new technologies and infrastructure--the missiles, the support structure, the launch sites, and all the associated items, but all these were to progress simultaneously. Schriever used the comparison of making General Motors also build roads, bridges, and

service stations and teach drivers' education all at once to illustrate the tasks required of the WDD.[4]

Since time was the critical factor, the efforts at WDD began with that end in mind. From the inception of WDD in 1954, they projected an operational ICBM by 1960. Using that deadline, WDD worked the timeline backwards establishing program goals and milestones as they went.[5] Lead-time was the crucial question. WDD estimated it would take twenty-six months to build the factory to fabricate the initial prototypes, forty months to construct the operational bases, and thirty-three months to develop the training program and teach the operational crews and maintenance personnel.[6] In order to meet the initial operational date, actions needed to start long before a traditional sequential development system required. The training of the operational crews and maintenance personnel demonstrates this idea. The WDD began preparing course outlines in the fall of 1956 in preparations to begin training the launch crews in October 1957.[7] Again the training was a unique problem set, it was not an upgrading of a previously available commodity, either pilot or maintenance personnel, the missile crew and maintenance personnel would be working on completely unique systems. When WDD began planning for the training, Atlas was scheduled to be operational in late 1959 and had not yet enjoyed a successful test launch.

The binding that kept all of the various projects and development of equipment from spinning into a million different pieces and directions was the weapon system concept. As discussed previously the weapon system concept addresses each aspect required to create a fully operational weapon and strives to maintain the focus on the complete weapon system so that no one piece becomes lost in the development. An

example of the failure to properly apply the weapon system concept occurred during the B-36 development. No tractor was available in the Air Force inventory to tow the airframe and without this important capability; the airplane could not become an operational weapon system. Schriever and WDD avoided such mistakes by identifying and tracking each component and its inherent interrelationship with others in minute detail. The idea of a systems approach was not the creation of Schriever or WDD; the Air Force experimented with it through the late 1940s. The crucial drawback was in the application. The Air Force originally applied the systems approach only to its contractors. The service itself was still functionally organized along the lines of the component development process.

Schriever addressed this imbalance between the systems management approach and the Air Force's functional organization in a report generated while he served at the Pentagon, "Combat Ready Aircraft: How Better Management Can Improve the Readiness of the Air Force."[8] In the Combat Ready Aircraft report, Schriever argued the Air Force had not always understood that a "complete weapon means not only the airframe, and the propulsion, armament, and electronic systems within the airframe, but also the ground support equipment facilities, and spare parts required for satisfactory service."[9] The report noted that in the past the Air Force had failed to appreciate that development lead-time varied between components. In addition, while the program started as a weapon system, the Air Force divided the management and control between commands, which in turn assigned it to one of its field development agencies. No agency had the power to tie the development of each component and keep the complete weapon

system under control. The development of the component became an end to itself and their relationship to the overall weapon system, a secondary consideration.[10]

Keeping the weapon system concept together was the direct result of the authority and responsibility vested in Schriever and WDD. The Teapot Committee Report laid the foundations for this authority. In Mr. Gardner's cover letter of the Teapot Committee report, he noted the requirement to establish a management structure within the Air Force, which would permit the work to be accomplished through a centralized authority.[11] Lieutenant General Thomas Power, Commander ARDC, established this authority within the ARDC chain of command when he delegated to Schriever "complete control and authority over all aspects of the Atlas program."[12] In addition, the Air Force also gave Schriever the authority to bypass ARDC and communicate directly with other major commands, the Air Staff, and the Secretary of the Air Force.[13] These extraordinary provisions provided a framework for the work completed by Schriever and the WDD. Schriever provided an insight into these capabilities in the following passage:

> Once the money was appropriated, I had control of those monies. It was identified for certain things, but I had a great deal of flexibility in moving money around. For example, I had enough flexibility to start a feasibility program for solid propellant. In the summer of 1955 the von Karman Committee said that a solid propellant ICBM was possible; that suggested a feasibility program. I didn't have to go to the Pentagon for that because I had the $29 million to go ahead with it.[14]

To create the system that allowed the achievement of an operational ICBM at the earliest possible time, Gardner and Schriever used the studies they helped initiate.

As the Atlas program grew, it became apparent the management of the program and not the development of technology dictated the pace and determined if the goal of

creating an operational system would be achieved within the timelines.[15] Schriever exercised his authority and responsibility through a system WDD called management control system. The system implemented a comprehensive data collection system which enabled Schriever and WDD to integrate fully the weapon system concept and concurrency.[16] The management control system provided a means to verify the progress on subsystems during development of the missile programs. The previously discussed Black Saturday meetings, where all this information was brought together and briefed to the leadership of WDD and Ramo-Wooldridge, were the keystones of the management control system. A large, secured conference room contained over four hundred charts and graphs derived from information gathered through the management control system. As examples, among the displays were milestone charts for the nose cone, guidance and control, engine test, and fully guided missile.[17] The collection of this data to this level of detail on all the aspects of the program allowed Schriever and the entire WDD team to understand where any potential problems were in each aspect of the development.

Parallel Efforts

As the management control system tracked the progress of Atlas through each of the major systems, it was also tracking parallel programs for many of these systems. The timelines did not allow any system to be a complete failure. One way they precluded such failure was that two different contractors often worked two different solutions to the same component or problem. Since many of the technologies involved were not completely developed, WDD also had parallel efforts on many of the major components and subsystems of the Atlas program. Uncertain which engines, guidance systems, or reentry vehicle would work best, the WDD sponsored two firms each developing a

different design, in each area. In executing this parallel approach the Air Force hired North American Aircraft (later Rocketdyne) and Aerojet General to build the engines; AC Spark Plug and American Bosch Arma to develop the all-inertia guidance system; General Electric and Burroughs Corporation to develop the radio inertia system; and AVCO and General Electric to design and produce reentry vehicles.[18] Although this methodology was criticized as uneconomical, WDD insisted it saved time through competition, ensured the development could not be halted by a one-contractor failure, and permitted work on advanced designs without jeopardizing the ICBM program.[19]

In addition to the redundant efforts of the Atlas program, in the fall of 1955, WDD started development of a second ICBM, the Titan. The liquid fueled Titan provided improvements over the Atlas design and served as another hedge against a catastrophic failure in Atlas. The Titan program brought in a new set of subcontractors for the subsystems and served as a backup for subsystems within the Atlas as well as a backup for the Atlas system as a whole.[20] The Titan design included improvements in the ability to withstand attack since it was designed to launch from hardened underground silos. It was also more efficient since it used a true two-stage rocket engine. The Atlas design developed using a stage and a half system to avoid the igniting of the second stage in the vacuum of space. The igniting of the second stage in the vacuum of space was not a technical problem but at the time when Atlas was originally designed, this fact was not known and the safer solution of igniting the all the stages on the ground was implemented. This safer solution added the weight of the first stage, which was carried throughout the powered flight. Titan was therefore a more efficient user of the power provided by its engines since its design shed the first stage after it burnt out. Although,

Schriever resisted the introduction of Titan because he believed it would pull vital resources and priority from the Atlas program, his position changed when the advisory council of scientists led by Dr. von Neumann joined the push for a second ICBM program.[21]

In addition to the Titan, beginning in the fall of 1955, WDD led the development and deployment efforts for an IRBM. The Killian Report provided the impetus behind obtaining the highest national priority for ICBM development and creating the previously discussed Gillette Procedures, but the Killian Report led to more work for the WDD. The Killian Report recommended the United States pursue the deployment of an intermediate range ballistic missile.[22] The committee wanted to counter the Soviet Union's development of IRBMs and believed the IRBMs were technologically easier to develop than ICBMs and therefore deployed before ICBMs.[23] The development of the Air Force's IRBM, the Thor was assigned to the WDD. In addition to the IRBM developed under WDD's supervision, the Army gained approval to develop a second IRBM, the Jupiter. In part of the continuing conflicts over roles and missions, the Army developed Jupiter, but when it deployed it became an Air Force asset. The Thor shared many of the same design features as the Jupiter. Similarly to Titan development, Schriever initially opposed the development of these weapon systems, because of their potential to distract resources and the limited industrial capacities from the ICBM development program.

<u>Testing</u>

One of the primary issues Schriever and WDD needed to solve was testing. Since pilots' reports would not be available and the airframe in question would be expended during flight testing, testing was a unique problem for ICBMs. WDD developed four

major facets to its testing regime: 1. No dead-end testing; 2. Ground test whenever possible; 3. All testing done at lowest possible level; and 4. Flight test results are utilized to the maximum extent possible. No dead-end testing meant "that no component is tested except in the configuration in which it will appear in the production version of the missile."[24] This required that components tested came from production lines using the same procedures that full production required.[25] An exception to this rule occurred during the testing of the nose cone, which used the Lockheed X-17 missile. The ground testing rule was an attempt to husband resources since the airframe or tested component could be recovered as opposed to when the missile was flight tested. The third rule, again an attempt to limit the number of expensive flight tests, required testing of subsystems and its components in an incremental manner to avoid catastrophic failure of flight tests and identify problems as the subsystems were developed.[26] The final maxim recognized the limitations of creating the conditions of ICBM flight without actually performing flight tests. Therefore, when flight tests were accomplished the greatest amount of usable data was extracted from every test. Another important aspect of this test philosophy was that the Air Force and not the contractors would control the missile test.[27]

Compromises

The need to deploy quickly, Atlas drove compromises in the basing and operational capabilities of the missiles. The first compromise was in the ability of the deployed system to withstand direct attack in a nuclear environment. The first three Atlas squadrons were not deployed in hardened configurations. This deployment mode greatly reduced the construction time of the operational sites. These sites were constructed to withstand overpressures of only five pounds per square inch with the

missiles were stored horizontally within a 103 by 133 foot launch and service building.[28] In order to launch the missile the retractable metal roof was pulled back, the missile raised to the vertical position, fueled, and fired. All of this was above ground and much of it outside of any building. The above ground basing was only one of the compromises accepted in the quest for rapid deployment. Another compromise was the guidance system used within the first Atlas missiles. These missiles were equipped with a radio controlled inertia guidance system. This meant the missiles required inputs and corrections from ground stations as opposed to a completely inertial guidance system that was used on the later Atlas versions as well as Titans and Minutemen. A radio inertial system created another vulnerability because of the control station interface after a missile is launched and the economy measure of having one radio control station control more than one missile. Since the missiles were dependent on the ground based guidance, the launch sites were tightly clustered around the central guidance control facility. This meant a single nuclear warhead or even a catastrophic accident could destroy the complex. In addition, the rate of fire was also limited by the ground control station, which could only handle one missile every fifteen minutes.[29]

Construction

The development of the extraordinarily complex machines to create a legitimate deterrent force requires more than a demonstrated capability and solving numerous technical problems. A legitimate deterrent force requires operational deployment, which required construction of launch sites and launch control centers developed to withstand the nuclear war they were designed to prevent. By 1960 the operational deployment was

underway, but the project was huge and badly behind schedule with the construction of launch facilities and launch control centers.

The Army Corps of Engineers led the construction effort. The construction requirements were a moving target because of changes in missile design and changes in the number of missiles deployed. The Cold War spurred rapid growth of the ICBM program and the scope of the Corps of Engineers' construction effort expanded with it. The number of Atlas squadrons increased from four to twelve. Six squadrons each of Titan Is and Titan IIs were constructed and planning began to deploy thousands of Minuteman missiles. The Atlas, Titan, and Minuteman did not share a common launch facility or launch control center, but some of the support bases would be the home of multiple types and modifications of missiles. For example, F. E. Warren AFB, Wyoming where the second wing of Atlas missiles were deployed, became the location for a Minuteman wing (which was later upgraded from Minuteman Is to IIIs). The hardening of the launch facilities and launch control centers increased from Atlas to Titan to Minuteman. All of the early Atlas launchers were built at or near ground level; all subsequent launch facilities were hidden deep beneath the ground and hardened to withstand a nuclear attack. The net effect of the changes was that Army engineers had to build more launch facilities of a progressively more difficult design, in less time.[30]

WDD's use of concurrency frequently required when a missile design changed, the change forced the Corps of Engineers to alter the launch facilities, because work was often already underway on the operational sites. "All too often that meant ripping out work and starting over. For the Army, keeping up with the frequent change orders was an expensive and nerve-wracking process. For example, as of April 1962 the Corps of

Engineers had issued 2,676 contract modifications and change orders for the construction of the Atlas D, E, and F launch facilities. The cost of those changes was $96 million, a 40 percent increase over the base contract price."[31]

To address these cost overruns and coordinate the nationwide effort in July 1959, the Chief of Engineers in the Army Corps of Engineers established a special branch, the Los Angeles Field Office. Los Angeles Field Office reported directly to the Chief of Engineers and its offices were located with the WDD in Los Angeles. Although the creation of Los Angeles Field Office provided a greater degree of centralized coordination and control to the mammoth project, the changes were not enough. In 1960, construction was still badly snarled and Congress held hearings to investigate what the press had dubbed "the missile mess."[32] In August 1960, the Army established the Corps of Engineers Ballistic Missile Construction Office (CEBMCO) an independent organization under the Chief of Engineers, to supervise site construction. In April 1961, an agreement between the Air Force and the Corps of Engineers placed CEBMCO under the operational control of the Air Force Systems Command Ballistic Systems Division (BSD) the successor organization to the Air Force Ballistic Missile Division (AFBMD). This relationship remained until the Army disbanded the construction organization in 1967.[33] The following information helps provide a scale to the size of the projects involved. "By 1961 contractors had already moved 26 million cubic yards of earth and stone, poured more than 3 million cubic yards of concrete, and used 764,000 tons of steel Another indication of the size of the program was the labor devoted to it: in early 1961, 21,300 people were laboring to build the missile facilities."[34] While hardness was increased for each weapon system, the reduced size and increased standardization of

Minuteman led to reduced construction costs. The construction of twelve Atlas sites near Plattsburgh, New York cost $44 million. The increased ability to use prefabricated components and their smaller size led to lower costs for Minuteman. Building 150 Minuteman silos at Ellsworth AFB, South Dakota cost $75 million. On a unit-cost basis, an Atlas silo cost $3.6 million compared to $500,000 for a Minuteman launcher. The rate of construction was still massive--between 1961 and 1966 CEBMCO built 1,000 Minuteman launch facilities at the incredible rate of one every 1.8 days."[35]

To compound the issue, labor relations were an issue throughout the construction of the sites, and nearly all of the construction sites were struck with some type of labor unrest. For example, in late 1960, a dispute over working assignments at the Atlas E sites at Forbes AFB, Kansas between the hoisting engineers and electrical workers resulted in a two-month work stoppage.[36] The labor relations problem became so acute that in May 1961 the Kennedy Administration created a special commission under the Secretary of Labor to address the issue. The commission was called the Missile Site Labor Commission and was responsible for developing policies, procedures, and methods for solving labor problems.[37] In addition, a Labor Department Labor Relations Committee established field offices at each construction site. The Army Corps of Engineers and the Air Force appointed labor relations advisors at each site, and the site activation task force members represented DoD on the committees.

Long-term Impacts in Program Acquisition

The development of the weapon systems was only one impact. The Air Force implemented the procedures and philosophy developed while working the ICBM development across the Air Force. These procedures were formalized in the 375 series

regulations. Schriever, who became the commander ARDC in 1959, attempted to capture the philosophy of the original ICBM programs in the regulations and provide waivers when required for contingency situations. The Air Staff modified these procedures for use across all Air Force programs and the OSD adapted these procedures for use across the entire DoD. The increased bureaucracy built into the system as each level tried to adapt the system to its requirements created an unwieldy result that was later discarded. Schriever noted that any management system only has a limited lifespan and has a tendency to destroy itself under its own weight. He stated, "I have felt that you are lucky if any real good management approach in the bureaucracy lasts for five years."[38]

Conclusion

The results are impressive and the process sounds simple, but execution is complex. The risks are ever-present. The dilemma facing Schriever was development within the timeline. Using the weapon systems concept, the increased authority available to WDD, and concurrency allowed that goal to be achieved. First, the weapon system concept ensured no subsystem was left behind within the development and it helped Schriever consolidate the control of various subsystems that may have otherwise been tasked to other development agencies.[39] The overlapping of development phases, which became known as concurrency helped shorten the development timelines, but without the combination of the increased priority within the Air Force and defense community and increased authority exercised by WDD the overlap would have been less effective.

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[19] Neufeld, *Development of Ballistic Missile*, 119.

[20]Herbert York, *Race to Oblivion: A Participant's View of the Arms Race* (New York: Simon and Schuster, 1970), 96.

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[23]Ibid.

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[26]Ritland, 246.

[27]Neufeld, *The Development of Ballistic Missile*, 125.

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[29]Ibid., 213-214.

[30]Lonnquest and Winlker, 79.

[31]Ibid.

[32]Ibid.

[33]Ibid., 80.

[34]Ibid., 82.

[35]Ibid., 85.

[36]Ibid., 82.

[37]Neufeld, *The Development of Ballistic Missile,* 222.

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CHAPTER 4

REVOLUTION IN MILITARY AFFAIRS AND THE NUCLEAR STRATEGY OF THE EISENHOWER AND KENNEDY ADMINISTRATIONS

The Revolution in Military Affairs

Nuclear weapons and in particular the mating of thermonuclear weapons to ballistic missiles represented a revolution in military affairs (RMA). The unprecedented reduction in the time required for massive destruction provided the first indicator of this RMA. This potential for massive destruction has also created a ceiling to the scale of warfare for the United States since the end of World War II. In addition to these changes, this weapon system brought unique qualities to the equation of warfare. These qualities include the fact that ballistic missiles do not provide an inherent defensive capability. As noted by Bernard Brodie, "Those forces ["our major offensive forces" (nuclear weapons)] no longer interpose themselves between enemy and homeland, as armies did and still do wherever the chief burden of fighting is still theirs. The force or forces that today pose the main deterrent threat are those compromised in and exemplified by the Strategic Air Command, which does not become a shield if deterrence fails."[1] Another important consideration is this RMA, represented by combining nuclear capabilities and ballistic missiles, is not solely limited to the Cold War or the arena of a peer competitor. This RMA is ongoing as countries like Iraq, North Korea, and Iran acquire, or attempt to acquire, a nuclear capability and combine that capability with ballistic missiles.

The time required to accomplish destruction was changed by the introduction of nuclear weapons. The destructive capability of a thermonuclear weapon is measured in thousands to millions of tons of TNT and their accuracy in the hundreds of feet. The time

required for missiles that contain thermonuclear warheads to strike a target almost anywhere on the globe is approximately thirty minutes. Therefore, in one-half of an hour numerous cities and the majority of mobilization potential of any society could be reduced to nothing. In order to reach this magnitude, conventional forces would require years of effort and untold treasure. The magnitude of these changes led Robert McNamara, as Secretary of Defense, to testify that:

> Our objective is the defeat of the Communists. I do not believe we can achieve that victory by engaging in strategic nuclear war. . . . There would be such severe damage done to this country that our way of life would change, and change in an undesirable direction. . . . My personal opinion is . . . we cannot win a nuclear war, a strategic nuclear war in the normal meaning of win.[2]

The level of potential destruction that led Robert McNamara to this conclusion created a limitation in the conduct of war since the end of World War II. Technology and the increased lethality across all aspects of conflict are part of the equation, but the advancement represented by the combination of ballistic missiles and thermonuclear weapons is critical in these calculations. This reduction of the level of intensity at which war is conducted does not imply the individual's efforts or the individual battles are any less intense than in previous history. This reintroduction of "limited" war is reflected by the number of Americans killed in combat, which has dropped dramatically in the nearly sixty years since the advent of the nuclear age.[3] While many factors have contributed to this significant decline the overshadowing effect of the mating of "the bomb" and missile is certainly a major contributing factor.

The potential counterpoint is the return to limited war was a byproduct of the costly offensives and stalemates that destroyed generations on the western front during World War I. The argument that Western militaries changed their technologies and

doctrine to avoid the extremely high casualties of World War I does not consider the return to extremely high casualties produced in the fighting between Soviet Union and Germany during World War II. Another potential counter-position to the influence of nuclear weapons is that the de-revolution towards limited war was influenced by World War II's grinder that was moved off the ground and into the air. These destructive forces from World War II expanded to include the cities and civilians. The fact remains that the United States adjusted its scale of warfare. This adjustment created a threshold to avoid direct nuclear confrontation and limited the conduct of war. While other technological changes have impacted this shift of scales, the affect of nuclear weapons combined with ballistic missiles was significant. Every battle, campaign, or war that the United States has been involved in since World War II has had the specter of nuclear weapons as a consideration. While this consideration of nuclear weapons does not intend to imply the United States considered the use of nuclear weapons in each of these conflicts, this specter of nuclear weapons includes the potential for escalation and direct confrontation with another nuclear power, which limited the scope of the conflict as exemplified by the conflicts in Korea or Vietnam. The specter of nuclear weapons even influenced wars that did not directly involve United States armed forces. For example, during the Yom Kippur War in October 1973, the United States increased the readiness of its nuclear forces to send a clear message to the Soviet Union.[4] Every rule has an exception and the exception for this statement is Operation Just Cause. The exception, Operation Just Cause, presents an interesting hypothetical question--what actions would the United States have been willing to risk if Noriega had closer ties with Moscow, for example Fidel Castro and Cuba? Again, the argument is not the potential for the United States to

use nuclear weapons in a limited conflict. The consideration is the protection a peer competitor can provide by extending its nuclear umbrella over a surrogate state. This direct protection or the threat of escalation creates an environment, which influences and limits actions.

The compression of time required to launch and accomplish the destruction are not the only revolutionary capabilities within the weapons system. The nature of defense as related to these weapon systems is unprecedented. First, the weapon systems do not provide an inherent defensive capability.[5] As noted by Brodie, the only way a nuclear tipped ballistic missile accomplishes this defense is by attacking the enemy's nuclear forces before they attack. This paradoxical requirement for a first strike as a defensive action is one of the riddles of Cold War deterrence and demonstrates the weapon system and its implications were not purely technological in nature.[6] In addition to the lack of direct contribution to defense, except in the extreme, the characteristics provided by the combination of nuclear weapons and ballistic missiles are unique in the complex problem presented to an active defense--the ability to stop the delivery systems or reentry vehicles after their launch. During the height of the Cold War, the United States did not field the full capabilities of anti-ballistic defenses available to it under the Anti-Ballistic Missile Treaty. An increased number of missiles and the ability of missiles to carry multiple independently targeted reentry vehicles readily overloaded the technology of active defense. The advancement of technology and the increased threat not associated with a peer competitor led the United States to abrogate the Anti-Ballistic Missile Treaty and develop a national missile defense capability. The current Administration has

specifically stated the ballistic missile defense program is not directed at a peer competitor, but at emergent threats with a limited numbers of systems.[7]

Beyond creating new defensive capabilities against ballistic missile attack, the current policy of the United States has a goal of not allowing certain nations to enjoy even a limited capability. The recent events of Operation Iraqi Freedom demonstrated the commitment of the United States to limit the proliferation of weapons of mass destruction and ballistic missile capabilities. The National Strategy to Combat Weapons of Mass Destruction (WMD) December 2002 clearly states the following position:

> Some states, including several that have supported and continue to support terrorism, already possess WMD and are seeking even greater capabilities, as tools of coercion and intimidation. For them, these are not weapons of last resort, but militarily useful weapons of choice intended to overcome our nation's advantages in conventional forces and to deter us from responding to aggression against our friends and allies in regions of vital interest.[8]

This statement and the declarations of President Bush send a clear message about not letting Iraq join us on this side of the nuclear and ballistic missile RMA The actions taken by the United States as part of Iraqi Freedom indicate the significance of this RMA One of the key motivators of the invasion was to limit Saddam Hussein's access to WMD and in particular nuclear weapons. The United States engaged in a pre-emptive war to stop Iraq from possessing and proliferating WMD. The ability of an Iraq, North Korea, or Iran to launch an intermediate range ballistic missile with a nuclear weapon changes the very nature of regional stability and power projection for the United States. The possibility of an entire corps or carrier battle group destroyed in an instant creates a dilemma for the United States. The distinction made between our legitimate possession of nuclear weapons and a rogue country's illegitimate possession and exploitation in a

"militarily useful" manner with the National Strategy to Combat WMD begins to shed light on this matter. The deterrent strategies employed against the Soviet Union may not be effective against these states. A new set of deterrent strategies is required to address this new threat. The military action on Iraq is the beginning of this strategy. The United States sent a clear message about what nations will be allowed on our side of this RMA and what nations will be stopped short even through force if required.

Evolution of Deterrence Theory and National Policy

Bernard Brodie captured the essence of the RMA associated with nuclear weapons in 1946: Thus far the chief purpose of our military establishment has been to win wars. From now on its chief purpose must be to avert them. It can have almost no other useful purpose.[9]

When Brodie wrote the above passage, he was addressing the destructive power of atomic weapons. The combination of thermonuclear weapons and ICBMs raised the consequences (increased destructive power and decreased time required) several orders of magnitude. The method for "averting wars" has been deterrence. Joint Publication 1-02 defines deterrence as: "The prevention from action by fear of the consequences. Deterrence is a state of mind brought about by the existence of a credible threat of unacceptable counteraction."[10] The nuclear weapons policies and programs of the Eisenhower and Kennedy Administrations provided the doctrine for the new mission of avoiding war--deterrence.[11] The nuclear policies of the Eisenhower Administration are commonly labeled as "massive retaliation" and the nuclear policies of the Kennedy Administration are commonly labeled "flexible response." The closing year of the Truman Administration provided the foundation for both Eisenhower and Kennedy

administrations' policies in NSC-68. NSC-68 provided a framework for much the United States government's strategic thought and actions in relation to the Cold War and the Soviet Union. In the period between 1945 and 1953, the United States transitioned from a nuclear monopoly to a competition involving thermonuclear weapons with the Soviet Union. The strategy set out in NSC-68 was to contain the Soviet Union's influence and control. The reasoning provided stated that, ". . . any substantial further extension of the area under the domination of the Kremlin would raise the possibility that no coalition adequate to confront the Kremlin with greater strength could be assembled."[12] NSC-68 called for increased defense spending to offset the Soviet advantage and emphasized the importance of enlarging ". . . our technical superiority by an accelerated exploitation of scientific potential of the United States and our allies."[13] Each subsequent administration applied the basic premise of containing the expansion of Communism espoused in NSC-68 through the end of the Cold War. A critical tool in containing the expansion was the balance of deterrence and stability. While deterrence creates a fear in the opponent's mind, prohibiting them from taking certain actions, stability intends to avoid the creation of too great of fear that could lead an enemy to believe a nation is over-ready and thus create an environment of instability. The capabilities and policies pursued by an administration help create the products of deterrence and stability.

Massive Retaliation

Both the Korean War and the Soviets' successful detonation of a hydrogen bomb in August 1953 were factors in shaping the nuclear policy of the Eisenhower Administration. "President Eisenhower and Secretary of State, John Foster Dulles, convinced that their threat to use atomic weapons in Korea had ended the stalemate there,

believed future conventional wars could be deterred by the threat of rapid escalation."[14] The Eisenhower Administration announced a "New Look" to define defense policy. The nation experienced significant inflation as result of the economic policies and increased spending during the Korean War and the Eisenhower administration was determined to avoid these pitfalls.[15] The administration delineated its nuclear strategy in NSC Paper-162/2 entitled "Basic National Security Policy." NSC-162/2 clearly defined the issues that drove much of the administration's defense policy as meeting the Soviet threat while avoiding weakening the economy or undermining American values and institutions.[16] On 30 October 1953, President Eisenhower signed NSC-162/2, which emphasized the policy of "massive retaliation" against the prosecution of a general war by the Soviets through the bomber forces of SAC. In addition to the reliance upon massive retaliation, NSC-162/2 advocated the development and deployment of tactical nuclear weapons.[17] It also established the policy that nuclear weapons be considered "as available for use as other munitions" and encouraged development of plans for their use in limited as well as general war.[18] The avocation of tactical nuclear weapons clearly delineates the strategy from a pure massive retaliation doctrine, but through his statements and articles, which tended to emphasize the massive retaliation portion, John Foster Dulles formed the public discussion of the policy.

Eisenhower's Secretary of State, John Foster Dulles, publicly aired these strategic policies in a January 1954 speech to the Council on Foreign Affairs and focused on the massive retaliation portion. The speech began by criticizing the Truman Administration for having created a foreign policy geared almost entirely towards reacting to emergencies. "Emergency measures are costly; they are superficial; and they imply that

the enemy has the initiative." More importantly, Dulles said, was to look at national security from the perspective of a "long haul." "The 'Soviet Communists are planning for what they call 'an entire historical era,' Dulles said, 'and we should do the same. They seek, through many types of maneuvers gradually to divide and weaken the free nations by overextending them in efforts, as Lenin put it, are 'beyond their strength, so that they come to practical bankruptcy.' Then said Lenin, 'our victory is assured.' Then said Stalin will be 'the moment for the decisive blow.'"[19] He stated, "The way to deter aggression is for the free community to be willing and able to respond vigorously at places and with means of its own choosing," and the means of response "was to depended primarily upon a great capacity to retaliate, instantly."[20] Thus said Dulles "in the face of this strategy, measures cannot be judged adequate merely because they ward off an emergency danger. It is essential to do this, but it is also essential to do so without exhausting ourselves."[21] One source of the exhaustion referred to the by Secretary of State Dulles was the cost of maintaining conventional forces to match the capabilities of the Soviets or Chinese.

In an effort to maintain some control on the rising costs of defense, NSC-162/2 became the foundation of Eisenhower's defense strategy. "Massive retaliation was the first priority in the New Look. The SAC assumed responsibility for the massive retaliation mission, which required the elite Air Force group to be able to deliver a crippling blow against the Soviet homeland on a moment's notice."[22] The capabilities available to the crippling blow rested entirely on the bomber forces available to SAC. The bomber force, as previously discussed, was vulnerable to surprise attack. The development of Soviet ICBMs increased the possibility of surprise attack and was one of

the major concerns in both the Killian and Gaither Reports. Therefore, the Eisenhower Administration pursued an ICBM capability to have the ability to retaliate to a Soviet attack. During the timeframe of initial ICBM development, the United States Navy began to explore the potential of launching ballistic missiles from submarines. The conflict over limited resources led to debates between the Air Force and the Navy.

The debates between the Navy and the Air Force focused on the appropriate deterrent strategy. With the development of the Polaris missile, a nuclear tipped submarine launched ballistic missile; the Navy challenged the Air Force's monopoly on the delivery of strategic nuclear weapons. The Navy not only challenged with a new weapon system they developed a new deterrence strategy. Admiral Arleigh Burke, Chief of Naval Operations, proposed a concept of "finite deterrence" as an alternative to an escalating arms race. He observed that Soviet ICBMs made the mission to destroy Soviet nuclear capabilities impossible and all land forces vulnerable to surprise attack. Further, he stated that not only would hardening and defenses be expensive, but also such measures would cause the Soviets to produce more powerful weapons in response. Finite deterrence emphasized a secure striking force, which according to Admiral Burke would provide "time to think in periods of tension" by eliminating "the constant pressure to strike first in order to avoid being disarmed." It also provided the ability of selective and gradual response, the ability to "apply political coercion," and a stable nuclear state in which "neither side would be under pressure to expand its nuclear arsenal."[23] Finite deterrence did not advocate the capability of destroying nuclear delivery capabilities, but instead envisioned attacking cities after an attack by the adversary.

The Air Force countered finite deterrence by emphasizing the requirement to destroy Soviet nuclear delivery capability. In the *Air University Quarterly Review*, Brigadier General Robert C. Richardson, presented the argument that "the only rational military objective in war is the enemy force or targets that affect the forces" and "destruction which does not affect the outcome of the war in one's favor is irrational and politically and morally unjustifiable."[24] In addition, his argument postulated that finite deterrence did not offer sufficient forces to deter limited acts of aggression or attacks on United States allies; nor would it be able to protect the United States from surprise attack or provide the capability to preempt in the case of general escalation.[25] General Thomas D. White, Air Force Chief of Staff, stated, "US policy must encompass the requirement for forces adequate to permit the United States to have initiative under all circumstances of war."[26]

The massive deterrence label associated with the policies of the Eisenhower Administration fail to recognize the flexibility built into the policies. The introduction of tactical nuclear weapons is an example of this flexibility. Instead of the common massive retaliation nomenclature, the policies of the Eisenhower Administration are more appropriately labeled as finite deterrence.[27] While the administration did not fully adopt the finite deterrence ideas postulated by the Navy, the nuclear forces and policies developed during Eisenhower's years in office emphasized the ability to strike back after an attack and deliver unacceptable damage to an adversary and are summarized in the following passage:

> Thus, Eisenhower did not favor either a purely "counterforce" or a "countervalue" targeting strategy. He rejected both the idea of planning to strike only military and political targets and a "cities only" targeting policy. . . . Deterrence depended

> on mutual perceptions to the extent that the Soviets shared Eisenhower's assessment that nuclear war was unwinnable. Once that perception became an accepted fact of the nuclear age in Washington and Moscow, perceptions about the overall balance of power between the two superpowers could not be significantly altered by increasing overkill capabilities. "How many time do we have to destroy Russia?" Eisenhower often asked his military advisors.[28]

The strategic policies and programs of the Eisenhower Administration assumed the "balance of terror" was relatively stable and not overly sensitive to the introduction of new weapons.[29] This concept led the administration to limit the growth of the nuclear arsenal, but still pursue new capabilities like ICBMs and early warning systems. The linked ideas of deterrence, flexible response, and defense against nuclear attack demonstrate how Eisenhower's New Look offered a balanced military strategy that was consistent with the Administration's containment policy.

Flexible Response

The Kennedy Administration believed massive retaliation lacked flexibility and the New Look had forced too many cuts in conventional forces.[30] The displeasure with massive retaliation was not new to President Kennedy. On 14 August 1958 from the Senate, he addressed the issues of the missile gap and massive retaliation calling for increased funding to close the gap as soon as possible and denouncing "the Maginot-line reliance upon the military answer of massive retaliation."[31] As discussed earlier, Kennedy's campaign position claimed a missile gap with the Soviets was developing and his new administration took immediate steps to address both the missile gap and the flexibility concerns. They rejected massive retaliation as being suicidal and lacking credibility since it provided the United States with the choice of either humiliation or holocaust.[32] The defense policies of the Kennedy administration centered on improving

flexibility, and hence the political utility of all military forces. This was especially important in two areas: the buildup of conventional forces and the restructuring of strategic forces. The goal for strategic forces was to make its use more credible by not tying it, as in the past, to the threat to launch an all-out strike in the event of enemy aggression, no matter how slight or ambiguous.[33] Within three months of taking office, the administration submitted a supplemental budget that increased the production of both the Minuteman and Polaris.[34] On 1 March 1961, Kennedy's Secretary of Defense, Robert McNamara, assigned to the Chairman of the Joint Chiefs of Staff, General Lyman Lemnitzer, and the Assistant Secretary of Defense for International Security Affairs, Mr. Paul Nitze, the job of preparing a memorandum revising basic national security policies relating to nuclear weapons, "including the assumptions relating to 'counterforce' strikes and the initiation of the use of tactical nuclear weapons" to include increased flexibility of execution options.[35] This led to the revision of the Single Integrated Operational Plan-62 (SIOP-62) using the following guidelines: 1. China and the satellites countries were separated from the USSR for targeting purposes; 2. Soviet strategic forces were separated from Soviet cities on United States target lists; 3. Strategic reserves were held by the United States in accordance with the concept intrawar deterrence; 4. United States command and control systems were to be protected to allow "controlled response," and 5. Soviet command and control was to be preserved, at least in the initial stages of any nuclear exchange.[36] Using these guidelines, five options and several sub-options were provided to allow for a spectrum of responses. These options differentiated between Soviet nuclear forces, Soviet conventional forces not collocated with cities, Soviet forces

near cities, Soviet command and control centers, and urban-industrial targets. SIOP-63 went into effect 1 August 1962.[37]

By developing more options within the SIOP, the administration began its move toward a counterforce doctrine. McNamara publicly acknowledged the pursuit of a "no-cities" counterforce strategy in January of 1962 during his testimony before the House Appropriations Committee, he stated that the "mission of the strategic retaliatory forces is to deter was by their capability to destroy the enemy's war-making capabilities." He further revealed that United States plan included the capability to either target or spare cities.[38] On 16 June 1962, during a commencement speech at Ann Arbor, Michigan he provided the following insights:

> The U.S. has come to the conclusion that to the extent feasible, basic military strategy in a possible general nuclear war should be approached in much the same way that more conventional military operations have been regarded in the past. That is to say, principle military objectives, in the event of nuclear war stemming from a major attack on the Alliance, should be the destruction of the enemy's military forces, not his civilian population . . . we are giving a possible opponent the strongest imaginable incentive to refrain from striking our cities.[39]

A flurry of criticism flowed as a result of this speech. Much of it centered on the first strike implications of the no cities approach since the only time ICBMs were vulnerable was before launch (and ICBMs by this time compromised the majority of the Soviet nuclear forces). Other arguments against a no cities strategy came from our European allies with significantly fewer nuclear capabilities who still believed in a city busting strategy. In addition, the Soviets discounted the credibility of a controlled counterforce war and the Services used counterforce and no cities as rationale for increased forces.[40]

The Kennedy Administration and McNamara began to distance themselves from the no cities strategy and started movement towards Assured Destruction and Damage Limitation. The fiscal year 1966 defense budget stated:

> The strategic objective of our general nuclear war forces are (1) to deter a deliberate attack upon the United States and its allies by maintaining a clear and convincing capability to inflict unacceptable damage on an attacker to strike first; [and] (2) in the event such a war should nonetheless occur, to limit damage to our populations and industrial capacities.[41]

McNamara defined the first objective as "assured destruction" and the second as "damage limitation." A series of quantitative studies accomplished by OSD supported the administration's shift from pure counterforce to assured destruction and damage limitation. These studies were war game simulations that examined the damage inflicted on the United States and Soviet Union by an exchange of nuclear weapons.[42] These studies showed the United States could not successfully limit damage to itself from a Soviet attack by either offensive or defensive means. The size and capabilities of Soviet missile forces made attempts to limit damage by greatly increasing the deployment of United States forces prohibitively expensive and only marginally effective.[43]

Minuteman

The new developments in strategy drove changes in force structure. The capabilities for the Minuteman were upgraded to more readily fit the flexible response, counterforce, and damage limitation criteria. These improvements included greater target selectivity, accuracy, and multiple reentry vehicles. The original purpose of the Minuteman was envisioned a less costly alternative to liquid fueled ICBMs and fired in a massive all or nothing salvo.[44] To meet the requirements of selective execution and greater flexibility the missile guidance system and launch control center computers were

redesigned to allow remote data change and the storage of more than one target set within the missile.

The final force strength of Minuteman was also adjusted by the Kennedy Administration. The Air Force did not develop a unified position on the numbers of Minuteman ICBMs required. The Air Staff numbers ranged between 2,000 and 3,000, while General Power, CINCSAC, advocated a requirement for 10,000 Minuteman ICBMs and personally suggested that figure to President Kennedy.[45] The BSD (WDD's new name) proposed a final strength of 1,000 to 1,200. The damage limitations studies also helped McNamara finally cap the Minuteman force. Though the Joint Chiefs of Staff pressed for a total force size of 1,200, McNamara held the line at 1,000, in part because he believed it was the minimum number the military and Congress would accept, and in part because, as Dr. Herbert York said, the number 1,000 had some "mysterious significance" that helped in holding the force at that level. In December, President Johnson agreed with McNamara and established the final Minuteman force size at 1,000 missiles.[46] When McNamara decided upon the final number for Minuteman, he also cancelled the mobile version of the ICBM that was under development.

The policies pursued by the Kennedy Administration significantly altered the development of the second generation of ICBMs--Titan II and Minuteman. By the mid-1960s, McNamara's basic strategic concept and his plans to fulfill it were essentially complete. The final version of the strategy did not fit neatly into the labels counterforce or finite deterrence, but spanned both.[47] In a November 1962 interview with Stewart Alsop of the *Saturday Evening Post*, McNamara provide the following insight:

> Asked whether the Soviets also could reach full retaliatory power he answered, “Indeed yes”. . . . “When both sides have sure second strike capability,” he said, “then you might have a more stable balance of terror. This may seem a rather subtle point, but from where I’m sitting it seems a point worth thinking about.”[48]

This expression of nuclear parity allowed that the Soviets, secure in the knowledge they could retaliate after an American attack, would not be tempted into a pre-emptive first strike.

Conclusion

The RMA represented by the combination of thermonuclear weapons to ballistic missiles led to unprecedented changes in warfare. The time required to accomplish destruction changed by the introduction of these weapon systems. The potential for massive destruction created a ceiling to the scale of warfare for the United States since the end of World War II. This adjustment created a threshold to avoid direct nuclear confrontation and limited the conduct of war. The chief purpose for armed forces changed from winning wars to deterring wars. Every battle, campaign, or war that the United States has been involved in since World War II has had the specter of nuclear weapons as a consideration. This consideration of nuclear weapons does not intend to imply the United States considered the use of nuclear weapons in each of these conflicts, but that nuclear weapons and the possibility of escalation to a direct confrontation with a peer competitor impacted these conflicts. The fact that ballistic missiles do not provide an inherent defensive capability except in offensive use and the near inability to defend against that offensive use add credence to the fact this capability represents an RMA. One of the acknowledged reasons for the execution of Operation Iraqi Freedom was the commitment of the United States to limit the proliferation of weapons of mass destruction

and ballistic missile capabilities. The United States engaged in a pre-emptive war to stop Iraq from possessing and proliferating WMD. The potential complications of a hostile nation similar to an Iraq, North Korea, or Iran with the capability to launch an intermediate range ballistic missile with a nuclear weapon changes the very nature of regional stability and power projection for the United States. The deterrent strategies employed against the Soviet Union may not be effective against these states.

With the prime job for armed forces changing from winning wars to averting wars The method for "averting wars"--deterrence has increased in significance with the introduction of ICBMs. The nuclear weapons policies and programs of the Eisenhower and Kennedy Administrations provided the doctrine for the new mission of avoiding war--deterrence. The nuclear policies of the Eisenhower Administration are commonly labeled as massive retaliation and the nuclear policies of the Kennedy Administration are commonly labeled flexible response. In reality, massive retaliation encompassed more responses than a general nuclear war. The Eisenhower Administration's New Look provided a sound balance between deterrence, defense, and flexibility. The development of the first generation of ICBMs and IRBMs in limited numbers proved to be an effective policy as the strategic bomber appeared susceptible to surprise attack given the limits of the warning and detection system. With the development of the Polaris missile, a nuclear tipped submarine launched ballistic missile; the Navy challenged the Air Force's monopoly on the delivery of strategic nuclear weapons and advocated a change in the deterrence policy. This new policy was called finite deterrence and envisioned attacking cities after an attack by the adversary instead of the capability of destroying nuclear delivery capabilities. The Air Force countered finite deterrence by emphasizing the

requirement to destroy Soviet nuclear delivery capability. In the end, deterrence depended on mutual perceptions to the extent that the Soviets shared Eisenhower's assessment that nuclear war was not winnable.

As early as 1958, Kennedy attacked the policy of massive retaliation in his speeches. After his election, President Kennedy's Administration went about changing because of their belief that massive retaliation lacked flexibility and the New Look had forced too any cuts in conventional forces. The defense policies of the Kennedy Administration centered on improving flexibility, and hence the political utility of all military forces. The SIOP was revised to separate attacks upon nuclear forces, non-nuclear forces, urban area, and satellite countries and China. Initially the Kennedy Administration focused on a no cities pure counterforce strategy, but significant criticism and the inherent first strike nature of such a deterrent policy led them away from that strategy. The foundations for the deterrent strategy became damage limitation and assured destruction. Increased numbers and capabilities of the Soviet ICBM forces convinced McNamara that a pure damage limitation would greatly increase the number nuclear forces and be prohibitively expensive and only marginally effective.

The changes in strategy drove new developments in the characteristics and quantity of the force structure. The Minuteman was modified on order to meet the flexibility requirements of the new strategy. The first generation ICBMs, Atlas, and Titan I were eventually retired. The final number of Minuteman deployed was a very unscientific process with CINCSAC requesting 10,000 and BSD requesting 1,200. The damage limitations studies also helped McNamara finally cap the Minuteman force with the final Minuteman force size of 1,000 missiles.

[1]Bernard Brodie, *Strategy in the Missile Age* (Princeton, New Jersey: Princeton University Press, 1971), 225.

[2]George A. Reed, "U.S. Defense Policy. U.S. Air Force Doctrine and Strategic Weapons Systems, 1958-1964: The Case of the Minuteman ICBM" (Ph.D. diss., Duke University, 242. (UMI Dissertation Services, Ann Arbor, Michigan: UMI Dissertation Services, 1999.)

[3]Department of Veterans' Affairs, "America's Wars Fact Sheet," Available on-line from http://www.va.gov/pressrel/amwars01.htm; Internet; access on 20 February 2003.

[4]"DEFCON DEFense CONdition," Available on line from http://www.fas.org/nuke/guide/usa/c3i/defcon.htm; Internet; accessed on 21 May 2003.

[5]Brodie, *Strategy in the Missile Age*, 225.

[6]Williamson Murray, "Thinking About Revolutions in Military Affairs," *C600 Term II ansd II Syllabus/Book of Readings* (USACGASG CSI 2002), 670. This view in is contradiction with Dr. Murray's position in the article. Where he provides one paragraph to describe that nuclear weapons only matter to great power competition and are a purely technological RMA.

[7]*National Policy on Ballistic Missile Defense Fact Sheet*, Available on-line from http://www.whitehouse.gov/news/releases/2003/05/iraq/200330520-15.html; Internet; accessed on 21 May 2003.

[8]*National Strategy to Combat Weapons of Mass Destruction December 2002*, Available on-line from http://www.whitehouse.gov/news/releases/2002/12/WMD Strategy.pdf; Internet; accessed on 8 January 2003.

[9]Bernard Brodie, "Implications for Military Policy,"ed. Bernard Brodie. *The Absolute Weapon: Atomic Power and World Order* (New York: Harcourt, Brace and Company, 1946), 76.

[10]Department of Defense, Joint Publication 1-02, *Department of Defense Dictionary of Military and Associated Terms* (Washington, DC: Government Printing Office), 129.

[11]For clarity purposes, no distinction will be made between The Kennedy Administration and the Johnson Administration. Kennedy's nuclear policies were carried

over through the duration of the Johnson Administration and Robert McNamara remained the Secretary of Defense for the period under examination.

[12]Ernest R. May ed., *American Cold War Strategy: Interpreting NSC 68* (Boston: Bedford Books of St. Martin's Press, 1993), 26.

[13]Ibid., 72.

[14]Scott D. Sagan, *Moving Targets: National Strategy and National Security*, (Princeton, NJ: Princeton University Press, 1989), 23; and Russell F. Weigley, *The American Way of War: A History of United States Military Strategy and Policy* (Bloomington IN: Indiana University Press, 1973), 339.

[15]Russell F. Weigley, *The American Way of War: A History of the United States Military Strategy and Policy* (Bloomington Indiana: Indiana University Press, 1973), 400.

[16]Lawrence Freedman, *The Evolution of Nuclear Strategy* (New York: St Martin's Press, 1983), 81, which sited para 1b of NSC 162/2.

[17]David Alan Rosenberg, "U.S. Nuclear War Planning, 1945-1960," ed. Desmond Ball and Jeffrey Richelson, *Strategic Nuclear Targeting* (Ithaca and London: Cornell University Press, 1986), 44.

[18]Rosenberg, 44.

[19]Fred Kaplan, *The Wizards of Armageddon* (New York: Simon and Schuster, 1983), 174.

[20]Richard A. Paulsen, *The Role of US Nuclear Weapons in the Post-Cold War Era* (Maxwell AFB, Alabama: Air University Press, 1994), 4.

[21]Kaplan, 174.

[22]Zachary Shands Davis, *Eisenhower's Worldview and Nuclear Strategy* (PhD diss., University of Virginia, 1989), 280. (Ann Arbor, Michigan: UMI Dissertaion Information Services 1991).

[23]Paulsen, 7.

[24]Robert C. Richardson III, "The Fallacy of the Concept of Minimum Deterrence," *Air University Quarterly Review* 12, no. 1 (spring 1960): 112.

[25]Ibid.,112-113.

[26]Paulsen, 7. (Footnoted in original to Desmond Ball and Timothy Laur, eds., Strategic Air Command: People, Aircraft, and Missiles, 2d ed. (Baltimore, Md.: Nautical and Aviation Publishing Company of America, 1990), 56-57.

[27]Davis, 379; and Weigley, 436.

[28]Davis, 377-379.

[29]Jerome H. Kahan, *Security in the Nuclear Age: Developing U.S. Strategic Arms Policy* (Washington DC: The Brookings Institution, 1975), 69.

[30]Ibid., 74

[31]John F. Kennedy, *The Strategy of Peace*, ed. Allen Nevins (New York: Harper and Brothers, 1960), 42.

[32]Desmond Ball, "Toward a Critique of Strategic Nuclear Targeting," ed. Desmond Ball and Jeffrey Richelson, *Strategic Nuclear Targeting*, (Ithaca and London: Cornell University Press, 1986), 17-18.

[33]George A. Reed, 205.

[34]Henry S. Rowen, "The Evolution of Strategic Nuclear Deterrence," *Strategic Thought in the Nuclear Age*, general editor Hossein Amirsadeghi editor Laurence Martin (Baltimore Maryland: The John Hopkins University Press, 1979), 144; and Ball, *Politics and Force Structure*, 113.

[35]Desmond Ball, "Development of the SIOP, 1960-1983," Desmond Ball and Jeffrey Richelson ed., *Strategic Nuclear Targeting* (Ithaca and London: Cornell University Press, 1986), 62-62.

[36]Ibid., 63.

[37]Paulsen, 7; and Ball, "Development," 63.

[38]Ball, "Development," 64.

[39] Desmond Ball, *Politics and Force Levels*, (Berkeley: University of California Press, 1980), 197.

[40]Paulson, 10.

[41]Ball “Development,” 69.

[42]Reed, 259.

[43]Reed, 259-260

[44]Reed, 195.

[45]Ball, *Politics*, 169.

[46]Reed, 263.

[47]Henry L. Trewhitt, *McNamara* (New York: Harper and Row Publishers, 1971), 116.

[48]Trewhitt

CHAPTER 5

CONCLUSION

> When asked what was the single greatest accomplishment of the ballistic missile program, General Schriever replied, "Its single greatest contribution is that it has established for the U.S. a position of strategic superiority. There is little doubt in my mind that we started behind the Soviets in the ballistic-missile program."
>
> Ernest G. Schiebert,
> *A History of the U.S. Air Forces Ballistic Missiles*

In 1999, the Air Force renamed Falcon AFB to Schriever AFB in honor of General Bernard A. Schriever. Yet many in the Air Force do not know the accomplishments of General Bernard A. Schriever or his lasting contributions to the United States Air Force. At one time, he was on the cover of *Time* magazine. His development of the ICBM deterrent forces that helped keep the terrors of nuclear war at bay and his follow-on work in space systems development are his lasting contributions. Schriever's contributions were critical, but not the sole reason for the successful deployment of an ICBM deterrent force that allowed the United States to catch and then pass the Soviets in this important arena.

The Soviet Union actively pursued an ICBM capability while the United States waited approximately eight years before beginning an intensive program. The launching of the Sputniks and the test firing of the ICBM by the Soviet Union demonstrated the advantage enjoyed by the Soviets. The development program within the United States Air Force required an initial impetus from civilian scientists to overcome a troubled start. The fact that this start came from outside the Air Force can be explained since in the early 1950s, much of the leadership within the military side of the Air Force was wedded

to the manned bomber. The unknown capability of an ICBM competed with the well-proven capability of the manned bomber for limited resources.

From 1954 until 1959, General Schriever led the WDD and the team that created America's first operational ICBM. His previous experience as the Air Staff liaison to the scientific community and to what became the Scientific Advisory Board was critical in his success. Throughout the development, General Schriever's integrity and leadership were a critical contribution to the success of the program. The use of concurrency throughout the development process applied a complicated, financially costly, and risky tool that allowed the achievement of an operational capability before the Teapot Committee's estimated completion date. General Schriever surrounded himself with skilled and knowledgeable employees from Ramo-Wooldridge and with personally selected Air Force officers.

When examining ICBM development from the perspective of a world that has had operational ICBMs for forty plus years it is too easy to discount the inherent complications and difficulties. The risks were ever-present and the timeline left little room for error. The combination of an overarching weapon system approach, unprecedented authority empowered to WDD, and concurrency contributed to the achievement of that goal. First, the weapon system concept allowed complete integration of all components so that no essential subsystem was left behind within the development. It helped Schriever consolidate the control of various subsystems that may have otherwise been tasked to other development agencies. The overlapping of development phases, which became known as concurrency shortened the timelines, but without the

additional authority exercised by WDD and the increased priority within the Air Force and the DoD concurrency would have been less effective.

An operational ICBM mated with a thermonuclear weapon constituted a dramatic shift in the nature of warfare--an RMA. Evidence of this RMA rests in the time required to accomplish destruction; the change in the scale of warfare that created a threshold to avoid direct nuclear confrontation and limited the conduct of war. The chief purpose for armed forces changed from winning wars to deterring wars. Since the end of World War II, every battle, campaign, or war in which the United States has been involved has had the specter of nuclear weapons as a consideration. This consideration of nuclear weapons does not imply the United States considered the use of nuclear weapons in each of these conflicts, but that limits were set to avoid confrontation with an adversary that possessed these weapons or confront the nation before such capability could be perfected for example Operation Iraqi Freedom. Another indication of the RMA brought about by ICBMs is the fact that ICBMs do not provide an inherent defensive capability except in offensive use and the near inability to defend against that offensive use. The United States engaged in a pre-emptive war to stop Iraq from possessing and proliferating WMD.

As the first mission for armed forces changed from winning wars to averting wars, the method for averting wars, deterrence, has increased in significance with the introduction of ICBMs. The doctrine for the new mission of avoiding wars came from the nuclear weapons policies and programs of the Eisenhower and Kennedy Administrations. The nuclear policies of the Eisenhower Administration are commonly

labeled as massive retaliation, and the nuclear policies of the Kennedy Administration are commonly labeled flexible response. In reality, massive retaliation encompassed more responses than a general nuclear war. The Eisenhower Administration's New Look struck a sound balance between deterrence, defense, and flexibility. The mainstay of deterrence, the strategic bomber, presented a potential vulnerability to surprise attack. The development of the first generation of ICBMs and IRBMs in limited numbers proved to be an effective answer to this challenge. In addition to ICBMs and IRBMs, the Eisenhower Administration pursued the development of the Polaris missile; a nuclear tipped submarine launched ballistic missile. With this capability, the Navy challenged the Air Force's monopoly on the delivery of strategic nuclear weapons and advocated a change in the deterrence policy. This new policy, finite deterrence, envisioned attacking cities after an attack by the adversary instead of the capability of destroying an adversary's nuclear delivery capabilities. The Air Force countered "finite deterrence' by emphasizing the requirement to destroy Soviet nuclear delivery capability and limit damage to the United States and her allies. In the end, deterrence depended on mutual perceptions to the extent that the Soviets shared Eisenhower's assessment that nuclear war was not winnable.

President Kennedy's Administration backed away from massive retaliation because of their belief massive retaliation lacked flexibility, and the New Look had forced too any cuts in conventional forces. The defense policies of the Kennedy administration centered on improving flexibility, and hence the political utility of all military forces. Separate attacks upon nuclear forces, non-nuclear forces, urban area, and

satellite countries, and China were created under a SIOP revision. Initially, the Kennedy Administration focused on a no cities pure counterforce strategy, but significant criticism and the inherent first strike nature of such a deterrent policy led them away from that strategy. Damage limitation and assured destruction became the foundations for their deterrent strategy. Increased numbers and capabilities of the Soviet ICBM forces convinced McNamara that a pure damage limitation would greatly increase the number nuclear forces and be prohibitively expensive while only marginally effective.

The changes in deterrent strategy required new developments in the characteristics and quantity of the force structure. The Minuteman ICBM was modified in order to meet the flexibility requirements of the new strategy to include the ability to change the target data from the launch control centers and selectively execute portions of the Minuteman fleet. Despite the emphasis on scientific and cost analysis within the McNamara defense department, the final number of Minuteman deployed was a very unscientific process with CINCSAC requesting 10,000 and BSD requesting 1,200.

The examination of the ICBM development program and the strategy and policies involved helps one understand the implications of today's ICBM deterrent force. The peer competitor issues of the Cold War have dropped to the background within global political environment. The view that a Cold War enjoyed a stable environment is challenged by the urgency used to develop ICBMs. Today's environment is no more dynamic than the one faced by General Schriever and his team. Their use of a full range of tools to develop a critical answer to an adversary's challenge provides important insight. By using concurrency in combination with the increased authority and the

weapon system concept, to keep the entire system in focus during development, they successfully deployed ICBMs within the timeline. The use of multiple approaches to solve critical problems, along with their overarching management approach, shed light onto possible techniques for current weapon systems development.

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